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Technical Specification

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
User Equipment (UE) radio transmission and reception
(3GPP TS 36.101 version 8.2.0 Release 8)

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Contents

Foreword

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1 Scope

. The present document establishes the minimum RF characteristics and minimum performance requirements for E-UTRA User Equipment (UE).

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

[2] ITU-R Recommendation SM.329-10, "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".

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].

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

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

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

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

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.

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

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

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

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

3.2 Symbols

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

$BW_{Channel}$	Channel bandwidth
F	Frequency
$F_{Interferer}$ (offset)	Frequency offset of the interferer
$F_{Interferer}$	Frequency of the interferer
F_C	Frequency of the carrier centre frequency
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_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
N_{UL}	Uplink EARFCN
Rav	Minimum average throughput per RB
$P_{Interferer}$	Modulated mean power of the interferer
ΔF_{OOB}	Δ Frequency of Out Of Band emission

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
ACS	Adjacent Channel Selectivity
A-MPR	Additional Maximum Power Reduction
AWGN	Additive White Gaussian Noise
BS	Base Station
CW	Continuous Wave
DL	Downlink
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
E-UTRA	Evolved UMTS Terrestrial Radio Access
EUTRAN	Evolved UMTS Terrestrial Radio Access Network
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FRC	Fixed Reference Channel
HD-FDD	Half- Duplex FDD
MCS	Modulation and Coding Scheme
MOP	Maximum Output Power
MPR	Maximum Power Reduction
MSR	Maximum Sensitivity Reduction
OOB	Out-of-band
PA	Power Amplifier
REFSENS	Reference Sensitivity power level
r,m.s	Root Mean Square
SNR	Signal-to-Noise Ratio
TDD	Time Division Duplex
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Terrestrial Radio Access
UTRAN	UMTS Terrestrial Radio Access Network

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.xxx section y 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 Applicability of minimum requirements

In this specification the Minimum Requirements are specified as general requirements and additional requirements. Where the Requirement is specified as a general requirement, the requirement is mandated to be met in all scenarios

For specific scenarios for which an additional requirement is specified, in addition to meeting the general requirement, the UE is mandated to meet the additional requirements.

5 Frequency bands and channel arrangement

5.1 General

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

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

5.2 Frequency bands

E-UTRA is designed to operate in the frequency bands defined in Table 5.2-1.

Table 5.2-1 E-UTRA frequency bands

E-UTRA Band	Uplink (UL) eNode B receive UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) eNode B transmit UE receive F_{DL_low} – F_{DL_high}		Duplex Mode
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	[TBD] – [TBD]	[TBD] – [TBD]		FDD
13	777 MHz – 787 MHz	746 MHz – 756 MHz		FDD
14	788 MHz – 798 MHz	758 MHz – 768 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

5.3 TX–RX frequency separation

5.4 Channel arrangement

5.4.1 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.

5.4.2 Channel bandwidth

Requirements in present document are specified for the channel bandwidths listed in Table 5.4.2-1.

Table 5.4.2-1 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 5.4.2-1 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.

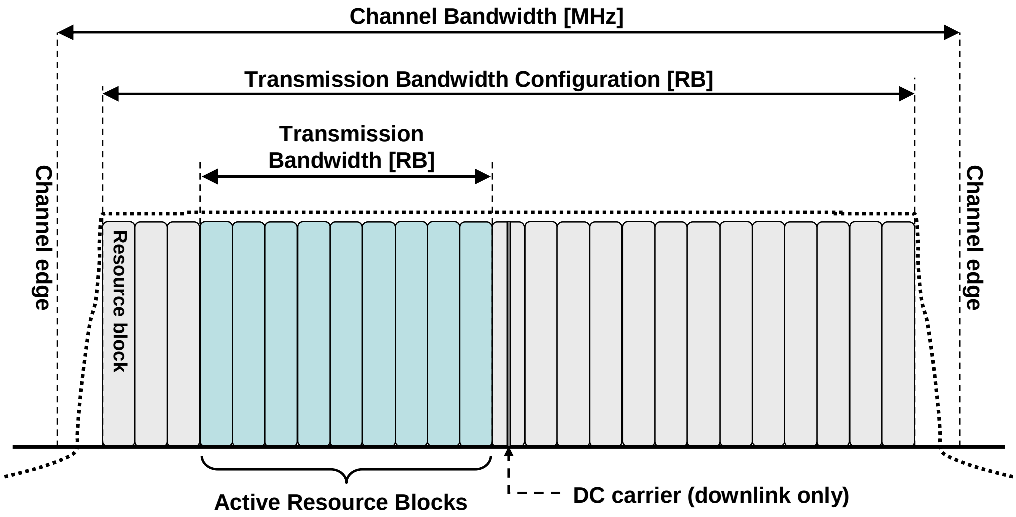

Figure 5.4.2-1 Definition of Channel Bandwidth and Transmission Bandwidth Configuration for one E-UTRA carrier.

5.4.2.1 Nominal channel bandwidth

Table 5.4.2.1-1 specifies the channel bandwidth that shall be supported per E-UTRA operating band for which all general and additional minimum performance requirements shall be met. The corresponding transmission bandwidth configuration in Table 5.4.2.1-1 shall be supported for each supported channel bandwidth.

Table 5.4.2.1-1: E-UTRA channel bandwidth

E-UTRA band / channel bandwidth						
E-UTRA Band	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
1			√	√	√	√
2	√	√	√	√		
3	√	√	√	√		
4	√	√	√	√	√	√
5	√	√	√			
6			√			
7			√	√	√	
8	√	√	√			
9			√	√		
10			√	√	√	√
11			√			
12						
13	√	√				
14	√	√				
...						
33			√	√	√	√
34			√	√	√	
35	√	√	√	√	√	√
36	√	√	√	√	√	√
37			√	√	√	√
38			√	√		
39			√	√	√	√
40				√	√	√

5.4.2.2 Additional channel bandwidth

Table 5.4.2.2-1 specifies the channel bandwidths that shall be supported per E-UTRA operating band for which certain relaxations of the UE performance are allowed. The transmission bandwidth configuration in Table 5.4.2.2-1 shall be supported for each supported channel bandwidth.

Table 5.4.2.2-1: Additional E-UTRA channel bandwidth

E-UTRA Band	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
1				[√]	[√]	[√]
2					[√]	[√]
3					[√]	[√]
4						
5				[√]		
6				[√]		
7						[√]
8				[√]		
9					[√]	[√]
10						
11				[√]	[√]	[√]
12						
13			[√[	[√]		
14			[√]	[√]		
...						
33						
34						
35						
36						
37						
38						
39						
40						

5.4.3 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.

5.4.4 Carrier frequency and EARFCN

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN). 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 5.4.4-1 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 5.4.4-1 and N_{UL} is the uplink EARFCN.

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

Table 5.4.4-1 E-UTRA channel numbers

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	13000	13000 – 13599
2	1930	600	600 – 1199	1850	13600	13600 – 14199
3	1805	1200	1200 – 1949	1710	14200	14200 – 14949
4	2110	1950	1950 – 2399	1710	14950	14950 – 15399
5	869	2400	2400 – 2649	824	15400	15400 – 15649
6	875	2650	2650 – 2749	830	15650	15650 – 15749
7	2620	2750	2750 – 3449	2500	15750	15750 – 16449
8	925	3450	3450 – 3799	880	16450	16450 – 16799
9	1844.9	3800	3800 – 4149	1749.9	16800	16800 – 17149
10	2110	4150	4150 – 4749	1710	17150	17150 – 17749
11	1475.9	4750	4750 – 4999	1427.9	17750	17750 – 17999
12						
13	746	5180	5180 – 5279	777	18180	18180 – 18279
14	758	5280	5280 – 5379	788	18280	18280 – 18379
…						
33	1900	26000	26000 – 26199	1900	26000	26000 – 26199
34	2010	26200	26200 – 26349	2010	26200	26200 – 26349
35	1850	26350	26350 – 26949	1850	26350	26350 – 26949
36	1930	26950	26950 – 27549	1930	26950	26950 – 27549
37	1910	27550	27550 – 27749	1910	27550	27550 – 27749
38	2570	27750	27750 – 28249	2570	27750	27750 – 28249
39	1880	28250	28250-28649	1880	28250	28250-28649
40	2300	28650	28650-29649	2300	28650	28650-29649

5.4.5 Void

6 Transmitter characteristics

6.1 General

Unless otherwise stated, the transmitter characteristics are specified at the antenna connector of the UE with a single transmit antenna. For UE with integral antenna only, a reference antenna with a gain of 0 dBi is assumed.

6.2 Transmit power

6.2.1 Void

6.2.2 UE Maximum Output Power

The following UE Power Classes define the nominal maximum output power. The nominal power is defined as the broadband transmit power of the UE, i.e. the power in the channel bandwidth (clause 5.2) of the radio access mode. The period of measurement shall be at least one [timeslot/ frame/TTI].

Table 6.2.2-1: UE Power Class

E-UTRA Band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
1					23	±2		
2					23	±2		
3					23	±2		
4					23	±2		
5					23	±2		
6					23	±2		
7					23	±2		
8					23	±2		
9					23	±2		
10					23	±2		
11					23	±2		
12					23	±2		
13					23	±2		
14					23	±2		
...								
33					23	±2		
34					23	±2		
35					23	±2		
36					23	±2		
37					23	±2		
38					23	±2		
39					23	±2		
40					23	±2		

Note
1. The above tolerances are applicable for UE(s) that support up to 4 E-UTRA operating bands. For UE(s) that support 5 or more E-UTRA bands the maximum output power is expected to decrease with each additional band and is FFS

6.2.3 UE Maximum Output power for modulation / channel bandwidth

For UE Power Class 3, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2-1due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3

Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

6.2.4 UE Maximum Output Power with additional requirements

Additional ACLR and spectrum emission requirements can be signalled by the network to indicate that the UE shall meet also additional requirements in a specific deployment scenario. To meet these additional requirements the concept of Additional Maximum Power Reduction A-MPR is introduced for the output power in Table 6.2.2-1

For UE Power Class 3 the specific requirements and identified sub-clauses are specified in table 6.2.4-1 along with the allowed A-MPR values that may be used to meet these requirements. The allowed A-MPR values specified below in Table 6.2.4.-1 are in addition to the allowed MPR requirements specified in clause 6.2.3.

Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR) / Spectrum Emission requirements

Network Signalling value	Requirements (sub-clause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks	A-MPR (dB)
NS_01	-	-	-		
			10	> 42	≤ 1
NS_02	6.6.2.4.1	1, 6, 9, 11	15	> 44	≤ 1
			20	> 48	≤ 1
	6.6.2.2.1	2, 4,10, 35, 36	3	>5	≤ 1
	6.6.2.2.1	2, 4,10, 35,36	5	>6	≤ 1
NS_03	6.6.2.2.1	2, 4,10, 35,36	10	>6	≤ 1
	6.6.2.2.1	2, 4,10,35,36	15	>8	≤ 1
	6.6.2.2.1	2, 4,10,35, 36	20	>10	≤ 1
NS_04	6.6.2.2.2	TBD	TBD	TBD	
NS_05	6.6.3.3.1	1[2]	10,15,20	> 50for QPSK	≤ 1
NS_06	6.6.2.2-3	13, 14	1.4, 3, 5, 10	n/a	n/a
..					
NS_32	-	-	-	-	-

Note: 0 ≤A-MPR ≤ 3

Note2: Applicable when the edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to 1920MHz + the Channel BW assigned. Operations below this point are for further study.

6.3 Output power dynamics

6.3.1 Power control

6.3.2 Minimum output power

The minimum controlled output power of the UE is defined as the broadband transmit power of the UE, i.e. the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the power is set to a minimum value.

6.3.2.1 Minimum requirement

The minimum output power is defined as the mean power in one sub-frame (1ms). The minimum output power shall be less than -40 dBm.

6.3.3 Transmit ON/OFF power

6.3.3.1 Transmit OFF power

Transmit OFF power is defined as the mean power when the transmitter is OFF. The transmitter is considered to be OFF when the UE is not allowed to transmit or during periods when the UE is not transmitting a sub-frame. During measurements gaps, the UE is not considered to be OFF.

6.3.3.1.1 Minimum requirement

The transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods. The requirement for the transmit OFF power shall be less than [ ] dBm

6.4 Control and monitoring functions

6.4.1 Out-of-synchronization handling of output power

6.5 Transmit signal quality

6.5.1 Frequency error

The UE modulated carrier frequency shall be accurate to within ±0.1 PPM observed over a period of one sub-frame (1ms) compared to the carrier frequency received from the E-UTRA Node B

6.5.2 Transmit modulation

Transmit modulation defines the modulation quality for expected in-channel RF transmissions from the UE. This transmit modulation limit is specified in terms of; an Error Vector Magnitude (EVM) for the allocated resources blocks (RB), an I/Q component and an in-band emissions for the non-allocated RB.

6.5.2.1 Error Vector Magnitude

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the IQ origin offset shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further modified by selecting the absolute phase and absolute amplitude of the Tx chain. The EVM result is defined after the front-end IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %. The measurement interval is one [timeslot] except when the mean power between slots is expected to change whereupon the measurement interval is reduced by [] µs at each end of the slot.

6.5.2.1.1 Minimum requirement

The RMS average of the basic EVM measurements for 10 consecutive sub-frames for the different modulations schemes shall not exceed the values specified in Table 6.5.2.1.1-1 for the parameters defined in Table 6.5.2.1.1-2.

Table 6.5.2.1.1-1: Minimum requirements for Error Vector Magnitude

Parameter	Unit	Level
QPSK	%	17.5
16QAM	%	12.5
64QAM	%	[tbd]

Table 6.5.2.1.1-2: Parameters for Error Vector Magnitude

Parameter	Unit	Level
UE Output Power	dBm	≥ -40
Operating conditions		Normal conditions
Power control step size	dB	[tbd]
Basic measurement period (Note 1,2)	[slot]	[] ms
Note 1: Less any [ ]µs transient periods Note 2: [ ]ms for FDD and [ ] ms for TDD		

6.5.2.2 IQ-component

The IQ origin offset is the phase and amplitude of an additive sinusoid waveform that has the same frequency as the reference waveform carrier frequency.

6.5.2.2.1 Minimum requirements

The relative carrier leakage power (IQ origin offset power) shall not exceed the values specified in Table 6.5.2.2.1-1.

Table 6.5.2.2.1-1: Minimum requirements for Relative Carrier Leakage Power

LO Leakage	Parameters	Relative Limit (dBc)
	Output power >0 dBm	-25
	-30 dBm ≤ Output power ≤0 dBm	-20
	-40 dBm ≤ Output power < -30 dBm	-10

6.5.2.3 In-band emissions

The in-band emission is defined as the average across 12 sub-carrier and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the [relative UE output power] of any non –allocated RB(s) and the [total UE output power] of all the allocated RB(s)

6.5.2.3.1 Minimum requirements

The relative in-band emission shall not exceed the values specified in Table 6.5.2.3.1-1.

Table 6.5.2.3.1-1: Minimum requirements for in-band emissions

In band emission	Relative emissions (dB)

$$\max\left[-25, (20 \cdot \log_{10} EVM) - 3 - 10 \cdot (\Delta_{RB} - 1) / N_{RB})\right]$$

6.5.2.4 Spectrum flatness

The spectrum flatness is defined as a relative power variation across the subcarrier of all RB of the allocated UL block. The spectrum flatness is measured as a dB value comparing the output power of a subcarrier and the average power per subcarrier.

6.5.2.4.1 Minimum requirements

The spectrum flatness shall not exceed the values specified in Table 6.5.2.4.1-1.

Table 6.5.2.4.1-1: Minimum requirements for spectrum flatness

Spectrum Flatness	Relative Limit (dB)
	Tbd.

6.6 Output RF spectrum emissions

The output UE transmitter spectrum consists of the three components; the emission within the occupied bandwidth (channel bandwidth), the Out Of Band (OOB) emissions and the far out spurious emission domain.

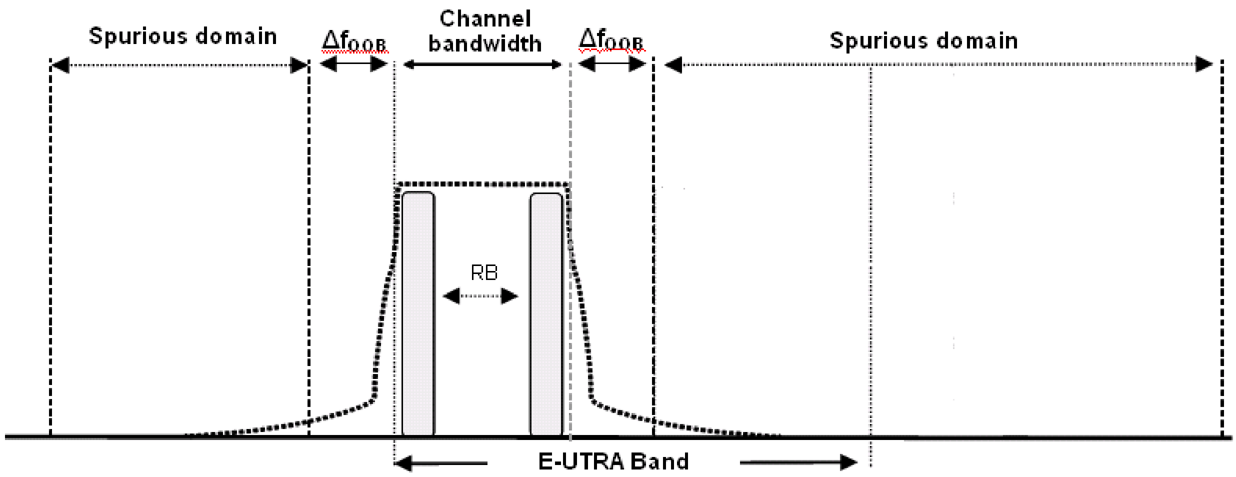

Figure 6.6-1: Transmitter RF spectrum

6.6.1 Occupied bandwidth

Occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than the channel bandwidth specified in Table 6.6.1-1

Table 6.6.1-1: Occupied channel bandwidth

	Occupied channel bandwidth / channel bandwidth					
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Channel bandwidth [MHz]	1.4	3	5	10	15	20

6.6.2 Out of band emission

The Out of band emissions are unwanted emissions immediately outside the assigned channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit is specified in terms of a spectrum emission mask and an Adjacent Channel Leakage power Ratio.

6.6.2.1 Spectrum emission mask

The spectrum emission mask of the UE applies to frequencies (Δf_{OOB}) starting from the ± edge of the assigned E-UTRA channel bandwidth. For frequencies greater than (Δf_{OOB}) as specified in Table 6.6.2.1.1-1 the spurious requirements in clause 6.6.3 are applicable.

6.6.2.1.1 Minimum requirement

The power of any UE emission shall not exceed the levels specified in Table 6.6.2.1.1-1 for the specified channel bandwidth.

Table 6.6.2.1.1-1: General E-UTRA spectrum emission mask

Δf_{OOB} (MHz)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	Measurement bandwidth
± 0-1	[TBD]	[TBD]	-15	-18	-20	-21	30 kHz
± 1-2.5	[-10]	[-10]	-10	-10	-10	-10	1 MHz
± 2.5-5	[-25]	[-10]	-10	-10	-10	-10	1 MHz
± 5-6		[-25]	-13	-13	-13	-13	1 MHz
± 6-10			-25	-13	-13	-13	1 MHz
± 10-15				-25	-13	-13	1 MHz
± 15-20					-25	-13	1 MHz
± 20-25						-25	1 MHz

Note: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth 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.

6.6.2.2 Additional Spectrum Emission Mask

This requirement is specified in terms of an "additional spectrum emission" requirement.

6.6.2.2.1 Minimum requirement (network signalled value "NS_03")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS_03" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.1-1.

Table 6.6.2.2.1-1: Additional requirements

	Spectrum emission limit (dBm)/ Channel bandwidth						
Δf_{OOB} (MHz)	**1.4 MHz**	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth**
± 0-1	[TBD]	[TBD]	-15	-18	-20	-21	30 kHz
± 1-2.5	[TBD]	[TBD]	-13	-13	-13	-13	1 MHz
± 2.5-5	[TBD]	[TBD]	-13	-13	-13	-13	1 MHz
± 5-6	[TBD]	[TBD]	-13	-13	-13	-13	1 MHz
± 6-10	[TBD]	[TBD]	-25	-13	-13	-13	1 MHz
± 10-15	[TBD]	[TBD]		-25	-13	-13	1 MHz
± 15-20	[TBD]	[TBD]			-25	-13	1 MHz
± 10-25	[TBD]	[TBD]				-25	1 MHz

Note: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth 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.

6.6.2.2.2 Minimum requirement (network signalled value "NS_04")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.2-1.

Table 6.6.2.2.2-1: Additional requirements

	Spectrum emission limit (dBm)/ Channel bandwidth						
Δf_{OOB} (MHz)	**1.4 MHz**	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth**
± 0-1	[TBD]	[TBD]	-15	-18	-20	-21	30 kHz
± 1-2.5	[TBD]	[TBD]	-13	-13	-13	-13	1 MHz
± 2.5-5	[TBD]	[TBD]	-13	-13	-13	-13	1 MHz
± 5-6	[TBD]	[TBD]	-25	-25	-25	-25	1 MHz
± 6-10	[TBD]	[TBD]	-25	-25	-25	-25	1 MHz
± 10-15	[TBD]	[TBD]		-25	-25	-25	1 MHz
± 15-20	[TBD]	[TBD]			-25	-25	1 MHz
± 10-25	[TBD]	[TBD]				-25	1 MHz

Note: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth 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.

6.6.2.2.3 Minimum requirement (network signalled value "NS_06")

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS_06" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.2.2.3-1.

Table 6.6.2.2.3-1: Additional requirements

	Spectrum emission limit (dBm)/ Channel bandwidth				
Δf_{OOB} (MHz)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	Measurement bandwidth
± 0-0.1	[TBD]	[TBD]	-15	-18	30 kHz
± 0.1-1	-13	-13	-13	-13	100 kHz
± 1-2.5	[TBD]	[TBD]	-13	-13	1 MHz
± 2.5-5	[TBD]	[TBD]	-13	-13	1 MHz
± 5-6		[TBD]	-25	-25	1 MHz
± 6-10			-25	-25	1 MHz
± 10-15				-25	1 MHz

Note: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth 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.

6.6.2.3 Adjacent Channel Leakage Ratio

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. ACLR requirements are specified for two scenarios for an adjacent E -UTRA and /or UTRA channel as shown in Figure 6.6.2.3 -1.

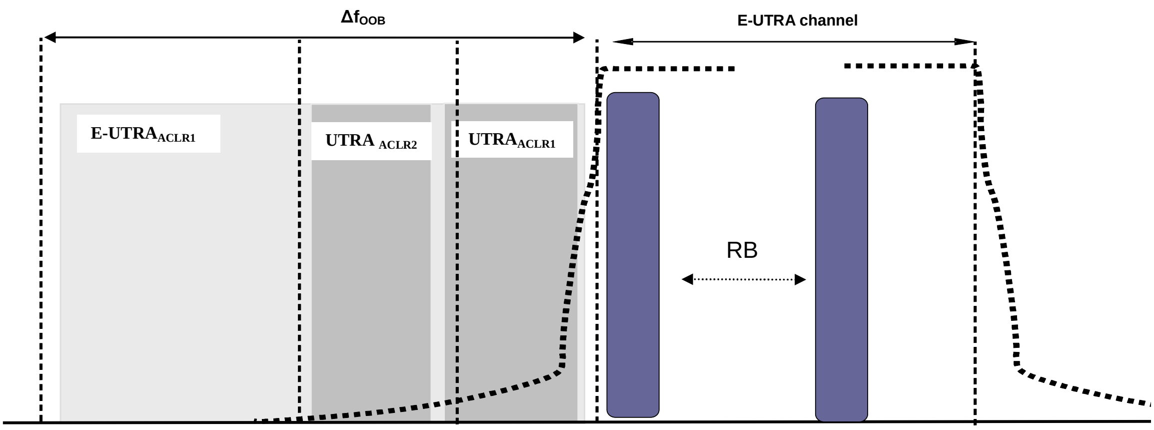

Figure 6.6.2.3-1: Adjacent Channel Leakage requirements

6.6.2.3.1 Minimum requirement E-UTRA

E-UTRA Adjacent Channel Leakage power Ratio ($E\text{-}UTRA_{ACLR}$) 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 E-UTRA on channel and adjacent channel power is measured with a rectangular measurement bandwidth filter.

Table 6.6.2.3.1-1: General requirements for $E\text{-}UTRA_{ACLR}$

	Channel bandwidth / $E\text{-}UTRA_{ACLR1}$ / measurement bandwidth					
	1.4 MHz	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
$E\text{-}UTRA_{ACLR1}$	30 dB	30 dB	30 dB	30 dB	30 dB	30 dB
E-UTRA channel Measurement bandwidth			4.5 MHz	9.0 MHz	13.5 MHz	18 MHz

6.6.2.3.2 Minimum requirements UTRA

UTRA Adjacent Channel Leakage power Ratio ($UTRA_{ACLR}$) is the ratio of the filtered mean power centred on the assigned E-UTRA channel frequency to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

UTRA Adjacent Channel Leakage power Ratio is specified for both the first UTRA 5 MHz adjacent channel ($UTRA_{ACLR1}$) and the 2nd UTRA 5MHz adjacent channel ($UTRA_{ACLR2)}$.The UTRA channel is measured with a 3.84 MHz RRC bandwidth filter with roll-off factor α =0.22. The E-UTRA channel is measured with a rectangular measurement bandwidth filter

Table 6.6.2.3.2-1: Additional requirements

	Channel bandwidth / $UTRA_{ACLR1/2}$ / measurement bandwidth					
	1.4 MHz	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
$UTRA_{ACLR1}$	33 dB	33 dB	33 dB	33 dB	33 dB	33 dB
$UTRA_{ACLR2}$	-	-	36 dB	36 dB	36 dB	36 dB
E-UTRA channel Measurement bandwidth		-	4.5 MHz	9.0 MHz	13.5 MHz	18 MHz
UTRA channel Measurement bandwidth	-	-	3.84 MHz	3.84 MHz	3.84 MHz	3.84 MHz

6.6.2.4 Additional ACLR requirements

This requirement is specified in terms of an additional $UTRA_{ACLR2}$ requirement.

6.6.2.4.1 Minimum requirements (network signalled value "NS_02")

"NS_02" is signalled by the network to indicate that the UE shall meet this additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

The Additional ACLR requirements is specified for the 2nd UTRA 5MHz adjacent channel ($UTRA_{ACLR2)}$ The UTRA channel is measured with a 3.84 MHz RRC bandwidth filter with roll-off factor α =0.22. The E-UTRA channel is measured with a rectangular measurement bandwidth filter.

Table 6.6.2.4.1-1: Additional requirements ($UTRA_{ACLR2}$)

	Channel bandwidth / $UTRA_{ACLR2}$ / measurement bandwidth					
	1.4 MHz	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
$UTRA_{ACLR2bis}$	-	-	43 dB	43 dB	-	-
E-UTRA channel Measurement bandwidth	-	-	4.5 MHz	9.0 MHz	-	-
UTRA channel Measurement bandwidth	-	-	3.84 MHz	3.84 MHz	-	-

6.6.3 Spurious emissions

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions. The spurious emission limits are specified in terms of general requirements inline with SM.329 [2] and E-UTRA operating band requirement to address UE co-existence.

6.6.3.1 Minimum requirements

The spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) from the edge of the channel bandwidth.

Table 6.6.3.1-1: Boundary between E-UTRA Δf_{OOB} and spurious emission domain

Channel bandwidth	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Δf_{OOB} (MHz)	[tbd]	[tbd]	10	15	20	25

The spurious emission limits in Table 6.6.3.1-2 apply for all transmitter band configurations (RB) and channel bandwidths.

Table 6.6.3.1-2: Spurious emissions limits

Frequency Range	Maximum Level	Measurement Bandwidth
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz

6.6.3.2 Spurious emission band UE co-existence

This clause specifies the requirements for the specified E-UTRA band

Table 6.6.3.2-1: Requirements

E-UTRA Band	Spurious emission limits						
	Protection Band	FDL_low – FDL_high (MHz)			Level (dBm)	Bandwidth (MHz)	Comment
1	1	2110	-	2170	[-50]	1	
	3	1805	-	1880	[-50]	1	
	6[1]	860	–	895	[-50]	1	
	7	2620	-	2690	[-50]	1	
	8	925	-	960	[-50]	1	
	9	1844.9	-	1879.9	[-50]	1	
	11	1475.9	-	1500.9	[-55]	1	
	33[4]	1900	-	1920	[-50]	1	
	34	2010		2025	[-50]	1	
	38	2570	-	2620	[-50]	1	
	39[4]	1880		1920	[-50]	1	
	Regulatory[3]	1884.5	-	1919.6	-41	0.3	
2	2	1930	-	1990	[-50]	1	
	4	2110	-	2155	[-50]	1	
	5	869	-	894	[-50]	1	
	10	2110	-	2170	[-50]	1	
	13	746	-	756	[-50]	1	

	14	758	-	768	[-50]	1	
3	1	2110	-	2170	[-50]	1	
	3	1805	-	1880	[-50]	1	
	7	2620	-	2690	[-50]	1	
	8	925	-	960	[-50]	1	
	33	1900		1920	[-50]	1	
	34	2010		2025	[-50]	1	
	38	2570	-	2620	[-50]	1	
4	2	1930	-	1990	[-50]	1	
	4	2110	-	2155	[-50]	1	
	5	869	-	894	[-50]	1	
	10	2110	-	2170	[-50]	1	
	13	746	-	756	[-50]	1	
	14	758	-	768	[-50]	1	
5	2	1930	-	1990	[-50]	1	
	4	2110	-	2155	[-50]	1	
	5	869	-	894	[-50]	1	
	13	746	-	756	[-50]	1	
	14	758	-	768	[-50]	1	
6	1	2110	-	2170	[-50]	1	
	6[1]	860	-	875	-37	1	
	6[1]	875	-	895	[-50]	1	
	9	1844.9	-	1879.9	[-50]	1	
	11	1475.9	-	1500.9	[-55]	1	
	Regulatory[3]	1884.5	-	1919.6	-41	0.3	
7	1	2110	-	2170	[-50]	1	
	3	1805	-	1880	[-50]	1	
	7	2620	-	2690	[-50]	1	
	8	925	-	960	[-50]	1	
	33	1900		1920	[-50]	1	
	34	2010		2025	[-50]	1	
	38[1,4]	2570	-	2620	[-50]	1	
8	1	2110	-	2170	[-50]	1	

	3[1]	1805	-	1830	[-50]	1	
	3[1, 2]	1805	-	1830	-36	0.1	
	3[1]	1830	-	1880	[-50]	1	
	7[1]	2640	-	2690	[-50]	1	
	7[1, 2]	2640	-	2690	-36	0.1	
	8	925	-	960	[-50]	1	
9	1	2110	-	2170	[-50]	1	
	6[1]	860	-	895	[-50]	1	
	9	1844.9	-	1879.9	[-50]	1	
	11	1475.9	-	1500.9	[-55]	1	
	Regulatory[3]	1884.5	-	1919.6	-41	0.3	
10	2	1930	-	1990	[-50]	1	
	4	2110	-	2155	[-50]	1	
	5	869	-	894	[-50]	1	
	10	2110	-	2170	[-50]	1	
	13	746	-	756	[-50]	1	
	14	758	-	768	[-50]	1	
11	1	2110	-	2170	[-50]	1	
	6[1]	860	-	895	[-55]	1	
	9	1844.9	-	1879.9	[-55]	1	
	11	1475.9	-	1500.9	[-55]	1	
	Regulatory[3]	1884.5	-	1919.6	-41	0.3	
13	2	1930	-	1990	[-50]	1	
	4	2110	-	2155	[-50]	1	
	5	869	-	894	[-50]	1	
	10	2110	-	2170	[-50]	1	
	13	746	-	756	[-50]	1	
	14	758	-	768	[-50]	1	
	Regulatory[3]	763	-	775	-35	0.00625	
14	2	1930	-	1990	[-50]	1	
	5	869	-	894	[-50]	1	
	10	2110	-	2170	[-50]	1	
	13	746	-	756	[-50]	1	
	14	758	-	768	[-50]	1	

	Regulatory[3]	763	-	775	-35	0.00625	
33	1	2110	-	2170	[-50]	1	
	3	1805	-	1880	[-50]	1	
	7	2620	-	2690	[-50]	1	
	8	925	-	960	[-50]	1	
	34	2010	-	2025	[-50]	1	
	38	2570	-	2620	[-50]	1	
	40	2300	-	2400	[-50]	1	
34	1	2110	-	2170	[-50]	1	
	3	1805	-	1880	[-50]	1	
	7	2620	-	2690	[-50]	1	
	8	925	-	960	[-50]	1	
	33	1900	-	1920	[-50]	1	
	38	2570	-	2620	[-50]	1	
	39	1880	-	1920	[-50]	1	
	40	2300	-	2400	[-50]	1	
35	34	2010	-	2025	[-50]	1	
	36	1930		1990	[-50]	1	
36	34	2010	-	2025	[-50]	1	
	35	1850	-	1910	[-50]	1	
37	34	2010	-	2025	[-50]	1	
38	1	2110		2170	[-50]	1	
	3	1805	-	1880	[-50]	1	
	33	1900		1920	[-50]	1	
	34	2010	-	2025	[-50]	1	
39	3[1]	1805	-	1850	[-50]	1	
	34	2010	-	2025	[-50]	1	
	40	2300	-	2400	[-50]	1	
40	1	2110		2170	[-50]	1	
	3	1805		1880	[-50]	1	
	33	1900	-	1920	[-50]	1	
	34	2010	-	2025	[-50]	1	
	39	1880	-	1920	[-50]	1	

Note

1 Indicates split band protection requirements are applicable
2 A number of exceptions are permitted and is FFS. For these exceptions the requirements of Table 6.6.3.1-2 are applicable
3 For band which are identified as 'Regulatory', regional requirement are applicable.
4 To meet these requirements some restriction will be needed for either the operating band or protection band

6.6.3.3 Additional spurious emissions

These requirements are specified in terms of an additional spectrum emission requirement.

6.6.3.3.1 Minimum requirement (network signalled value "NS_05")

Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS_05" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.6.3.3.1-1.

Table 6.6.3.3.1-1: Additional requirements (PHS)

Δf_{OOB} (MHz)	Channel bandwidth / Spectrum emission limit (dBm)						Measurement bandwidth
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
F_{UL_low} – F_{UL_high}	-41	-41	-41	-41	-41[1]	-41[1]	300 KHz
Note 1. Applicable when the edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to 1920MHz + the Channel BW assigned. Operations below this point are for further study.							

6.7 Transmit intermodulation

The transmit intermodulation performance 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 wanted signal and an interfering signal reaching the transmitter via the antenna.

7 Receiver characteristics

7.1 General

Unless otherwise stated the receiver characteristics are specified at the antenna connector(s) of the UE. For UE(s) with an integral antenna only, a reference antenna(s) with a gain of 0 dBi is assumed for each antenna port(s). UE with an integral antenna(s) may be taken into account by converting these power levels into field strength requirements, assuming a 0 dBi gain antenna. . For UEs with more than one receiver antenna connector, identical interfering signals shall be applied to each receiver antenna port if more than one of these is used (diversity).

The levels of the test signal applied to each of the antenna connectors shall be as defined in the respective sections below.

All the parameters in clause 7 are defined using the DL reference measurement channel specified in Annex A.3.2 and using the set-up specified in Annex C.3.1

7.2 Diversity characteristics

The requirements in Section 7 assume that the receiver is equipped with two Rx port as a baseline. Requirements for 4 ports are FFS. With the exception of clause 7.9 all requirements shall be verified by using both (all) antenna ports simultaneously.

7.3 Reference sensitivity power level

The reference sensitivity power level REFSENS is the minimum mean power applied to both the UE antenna ports at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

7.3.1 Minimum requirements (QPSK)

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A.3.2 with parameters specified in Table 7.3.1-1 and table 7.3.1-2

Table 7.3.1-1: Reference sensitivity QPSK $P_{REFSENS}$

Channel bandwidth							
E-UTRA Band	**1.4 MHz (dBm)**	**3 MHz (dBm)**	**5 MHz (dBm)**	**10 MHz (dBm)**	**15 MHz (dBm)**	**20 MHz (dBm)**	**Duplex Mode**
1			[-100]	[-97]	[-95.2]	[-94]	FDD
2			[-98]	[-95]	[-93.2]	[-92]	FDD
3			[-97]	[-94]	[-92.2]	[-91]	FDD
4			[-100]	[-97]	[-95.2]	[-94]	FDD
5			[-98]	[-95]			FDD
6			[-100]	[-97]			FDD
7			[-98]	[-95]	[-93.2]	[-92]	FDD
8			[-97]	[-94]			FDD
9			[-99]	[-96]	[-94]	[-93]	FDD
10			[-100]	[-97]	[-95.2]	[-94]	FDD
11			[-98]	[-95]	[-93.2]	[-92]	FDD
12							FDD
13			[-97]	[-94]			FDD
14							FDD
33			[-100]	[-97]	[-95.2]	[-94]	TDD
34			[-100]	[-97]	[-95.2]	[-94]	TDD
35			[-100]	[-97]	[-95.2]	[-94]	TDD
36			[-100]	[-97]	[-95.2]	[-94]	TDD
37			[-100]	[-97]	[-95.2]	[-94]	TDD
38			[-100]	[-97]	[-95.2]	[-94]	TDD
39			[-100]	[-97]	[-95.2]	[-94]	TDD
40			[-100]	[-97]	[-95.2]	[-94]	TDD
Note 1: The transmitter shall be set to maximum output power level (Table 7.3.1-2) Note 2: Reference measurement channel is [A.3.2] Note 3: The signal power is specified per port Note 4: For the UE which supports both Band 3 and Band 9 the reference sensitivity level of Band 3 + 0.5 dB is applicable for band 9							

Note 1: The relation to the received PSD is $\left\langle \mathrm{REF}\,\hat{I}_{or} \right\rangle = P_{REFSENS}\left(N_{sc}^{RB} N_{RB} \Delta f\right)^{-1}$ with N_{RB} is the maximum transmission configuration according to Table 5.4.2-1.

Table 7.3.1-2 specifies the minimum number of allocated uplink resource blocks for which the reference receive sensitivity requirement must be met. For larger transmission configurations a certain relaxation of the UE performance is allowed. Table 7.3.1-3 specifies the maximum output power level for which the reference receive sensitivity requirement must be met when UL resource blocks is the total resource blocks (Table 5.4.2-1) supported by the channel bandwidth.

Table 7.3.1-2: Maximum uplink configuration for reference sensitivity

E-UTRA Band / Channel bandwidth / N_{RB} / Duplex mode							
E-UTRA Band	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Duplex Mode**
1	-	-	25	50	75	100	FDD
2	6	15	25	50	[50[1]]	[50[1]]	FDD
3	6	15	25	50	[50[1]]	[50[1]]	FDD
4	6	15	25	50	75	100	FDD

5	6	15	25	[25[1]]	-	-	FDD
6	-	-	25	[25[1]]	-	-	FDD
7	-	-	25	50	[75[1]]	[75[1]]	FDD
8	6	15	25	[25[1]]	-	-	FDD
9	-	-	25	50	[50[1]]	[50[1]]	FDD
10	-	-	25	50	75	100	FDD
11	-	-	25	[25[1]]	[25[1]]	[25[1]]	FDD
12							FDD
13	6	15	[15-25]	[15-25]			FDD
14							FDD
...							
33	-	-	25	50	75	100	TDD
34	-	-	25	50	75	-	TDD
35	6	15	25	50	75	100	TDD
36	6	15	25	50	75	100	TDD
37	-	-	25	50	75	100	TDD
38	-	-	25	50	-	-	TDD
39			25	50	75	100	TDD
40				50	75	100	TDD

Note

1. Maximum number of UL resources blocks allocated is less than the total resources blocks supported by the channel bandwidth

Table 7.3.1-3: Maximum transmission power for reference sensitivity

	Channel bandwidth						
E-UTRA Band	**1.4 MHz (dBm)**	**3 MHz (dBm)**	**5 MHz (dBm)**	**10 MHz (dBm)**	**15 MHz (dBm)**	**20 MHz (dBm)**	**Duplex Mode**
1							FDD
2							FDD
3							FDD
4							FDD
5							FDD
6							FDD
7							FDD
8							FDD
9							FDD
10							FDD
11							FDD
12							FDD
13							FDD
14							FDD
Note 1: UE output power is less than the maximum output power							

7.3.2 (Void)

7.4 Maximum input level

This is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

7.4.1 Minimum requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.4.1.

Table 7.4.1-1: Maximum input level

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Wanted signal mean power	dBm	-25					

Note:

1. The transmitter shall be set to 4dB below the supported maximum output power.
2. Reference measurement channel is [Annex C 64QAM R=3/4]

7.5 Adjacent Channel Selectivity (ACS)

7.5.1 Minimum requirements

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a E-UTRA signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

The UE shall fulfil the minimum requirement specified in Table 7.5.1-1 for all values of an adjacent channel interferer up to –25 dBm. However it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.1-2 and Table 7.5.1-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2.

Table 7.5.1-1: Adjacent channel selectivity

		Channel bandwidth					
Rx Parameter	Units	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
ACS	dB	33.0	33.0	33.0	33.0	30	[27]

Table 7.5.1-2: Test parameters for Adjacent channel selectivity, Case 1

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Wanted signal mean power	dBm	REFSENS + 14 dB					
$P_{Interferer}$	dBm	REFSENS +[45]dB	REFSENS +[45]dB	REFSENS +[45]dB*	REFSENS +[45]dB	REFSENS +[42]dB	REFSENS +[39]dB
$BW_{Interferer}$	MHz	1.4	3	5	5	5	5
$F_{Interferer}$ (offset)	MHz	1.4	3	5	7.5	10	12.5

Note:

1. The transmitter shall be set to 4dB below the supported maximum output power.
2. The interferer consists of the Reference measurement channel specified in Annex A.3.2 with set-up according to Annex C.3.1

Table 7.5.1-3: Test parameters for Adjacent channel selectivity, Case 2

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
Wanted signal mean power	dBm	[-56.0]	[-56.0]	[-56.0]	[-56.0]	[-53.0]	[-50.0]
$P_{Interferer}$	dBm	-25					
$BW_{Interferer}$	MHz	1.4	3	5	5	5	5
$F_{Interferer}$ (offset)	MHz	1.4	3	5	7.5	10	12.5

Note:

1. The transmitter shall be set to 24dB below the supported maximum output power.
2. The interferer consists of the Reference measurement channel specified in Annex 3.2 with set-up according to Annex C.3.1

7.6 Blocking characteristics

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occur.

7.6.1 In-band blocking

In-band blocking is defined for an unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band at which the relative throughput shall meet or exceed the minimum requirement for the specified measurement channels..

7.6.1.1 Minimum requirements

2 The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.6.1.1-1 and 7.6.1.1-2.

Table 7.6.1.1-1: In band blocking parameters

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
Wanted signal mean power	dBm	REFSENS + channel bandwidth specific value below					
		6	6	6	6	7	9
$BW_{Interferer}$	MHz	1.4	3	5	5	5	5
$F_{Ioffset, case 1}$	MHz	2.1	4.5	7.5	7.5	7.5	7.5
$F_{Ioffset, case 2}$	MHz	3.5	7.5	12.5	12.5	12.5	12.5

Note:

1. The transmitter shall be set to 4dB below the supported maximum output power.
2. The interferer consists of the Reference measurement channel specified in Annex A.3.2 with set-up according to Annex C.3.1

Table 7.6.1.1-2: In-band blocking

E-UTRA band	Parameter	Units	Case 1	Case 2
	$P_{Interferer}$	dBm	-56	-44
	$F_{Interferer}$ (Offset)	MHz	=-BW/2 - $F_{Ioffset, case 1}$ & =+BW/2 + $F_{Ioffset, case 1}$	≤ -BW/2- $F_{Ioffset, case 2}$ & ≥ +BW/2 + $F_{Ioffset, case 2}$
1, 2, 3, 4, 5 7, 8, 9, 10, 11,13 33,34,35,36,37,38 ,39,40	$F_{Interferer}$	MHz	F_{DL_low} -7.5 to F_{DL_high} +7.5 (Note 3)	F_{DL_low} -15 to F_{DL_high} +15
6	$F_{Interferer}$	MHz	F_{DL_low} - 7.5 to F_{DL_high} +7.5 (Note 2 & 3)	F_{DL_low} -15 to F_{DL_high} +15 (Note 3)

Note

1. [The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidths ≥5 MHz]
2. For each carrier frequency the requirement is valid for two frequencies, the carrier frequencies -BW/2 - FIoffset, case 1 & + BW/2 + FIoffset, case 1.
3. For Band 6, the unwanted modulated interfering signal does not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive band

7.6.2 Out of-band blocking

Out-of-band band blocking is defined for an unwanted CW interfering signal falling more than 15 MHz below or above the UE receive band. For the first 15 MHz below or above the UE receive band the appropriate in-band blocking or adjacent channel selectivity in sub-clause 7.5.1 and sub-clause 7.6.1 shall be applied.

7.6.2.1 Minimum requirements

. The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.6.2.1-1 and 7.6.2.1-2.

For Table 7.6.2.1-2 in frequency range 1, 2 and 3, up to [TBD] exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of clause 7.7 Spurious response are applicable.

For Table 7.6.2.1-2 in frequency range 4, up to [TBD] exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a 1MHz step size. For these exceptions the requirements of clause 7.7 Spurious response are applicable.

Table 7.6.2.1-1: Out-of-band blocking parameters

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Wanted signal mean power	dBm	REFSENS + channel bandwidth specific value below					
		6	6	6	6	7	9

Note:

1. The transmitter shall be set to 4dB below the supported maximum output power.
2. Reference measurement channel is [A.3.2]

Table 7.6.2.1-2: Out of band blocking

E-UTRA band	Parameter	Units	Frequency range 1	Frequency range 2	Frequency range 3	Frequency range 4
	$P_{Interferer}$	dBm	[-44]	[-30]	[-15]	[-15]
1, 2, 3, 4, 5 6,7, 8, 9, 10,11,13 33,34,35,36,37, 38,39,40	$F_{Interferer}$ (CW)	MHz	F_{DL_low} -15 to F_{DL_low} -60	F_{DL_low} -60 to F_{DL_low} -85	F_{DL_low} -85 to 1 MHz	-
			F_{DL_high} +15 to F_{DL_high} + 60	F_{DL_high} +60 to F_{DL_high} +85	F_{DL_high} +85 to +12750 MHz	-
2, 5	$F_{Interferer}$	MHz	-	-	-	F_{UL_low} - F_{UL_high}

Note:

7.6.3 Narrow band blocking

This requirement is measure of a receiver's ability to receive a E-UTRA signal at its assigned channel frequency in the presence of an unwanted narrow band CW interferer at a frequency, which is less than the nominal channel spacing.

7.6.3.1 Minimum requirements

. The relative throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.6.3.1-1

Table 7.6.3.1-1: Narrow-band blocking

Parameter	Unit	Channel Bandwidth					
		1.4 MHz	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
P_w	dBm	$P_{REFSENS}$ + channel-bandwidth specific value below					
		22	18	16	13	14	16
P_{uw} (CW)	dBm	-55	-55	-55	-55	-55	-55
F_{uw} (offset for Δf = 15 kHz)	MHz	0.9075	1.7025	2.7075	5.2125	7.7025	10.2075
F_{uw} (offset for Δf = 7.5 kHz)	MHz						
Note 1: The transmitter shall be set a 4 dB below the supported maximum power. Note 2: Reference measurement channel is [A.3.2].							

7.7 Spurious response

Spurious response is a measure of the receiver's ability to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in sub-clause 7.6.2 is not met.

7.7.1 Minimum requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.7.1-1 and 7.7.1-2.

Table 7.7.1-1: Spurious response parameters

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Wanted signal mean power	dBm	REFSENS + channel bandwidth specific value below					
		6	6	6	6	7	7

Note:

1. The transmitter shall be set to 4dB below the supported maximum output power.
2. Reference measurement channel is [A.3.2]

Table 7.7.1-2: Spurious Response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

7.8 Intermodulation characteristics

Intermodulation response rejection is a measure of the capability of the receiver to receiver a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

7.8.1 Wide band intermodulation

The wide band intermodulation requirement is defined following the same principles using modulated E-UTRA carrier and CW signal as interferer.

7.8.1.1 Minimum requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.8.1.1 for the specified wanted signal mean power in the presence of two interfering signals

Table 7.8.1.1-1: Wide band intermodulation

Rx Parameter	Units	Channel bandwidth					
		1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Wanted signal mean power	dBm	REFSENS + channel bandwidth specific value below					
		[12]	[8]	6	6	7	9

$P_{Interferer\ 1}$ (CW)	dBm			-46	
$P_{Interferer\ 2}$ (Modulated)	dBm			-46	
$BW_{Interferer\ 2}$		1.4	3		5
$F_{Interferer\ 1}$ (Offset)	MHz	-BW/2 –2.1 / +BW/2+ 2.1	-BW/2 –4.5 / +BW/2 + 4.5		-BW/2 – 7.5 / +BW/2 + 7.5
$F_{Interferer\ 2}$ (Offset)	MHz			$2*F_{Interferer\ 1}$	
R_{av}	kbps				

Note:

1. The transmitter shall be set to 4dB below the supported maximum output power.
2. Reference measurement channel is [Annex C QPSK R=1/3]
3. The modulated interferer consists of the Reference measurement channel specified in Annex A.3.2 with set-up according to Annex C.3.1The interfering modulated signal is 5MHz E-UTRA signal as described in Annex D for channel bandwidth ≥5MHz

7.8.2 Narrow band intermodulation

7.8.2.1 Minimum requirements

7.9 Spurious emissions

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

7.9.1 Minimum requirements

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.1-1

Table 7.9.1-1: General receiver spurious emission requirements

Frequency Band	Measurement Bandwidth	Maximum level	Note
30MHz ≤ f < 1GHz	100 kHz	-57 dBm	
1GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	

8 Performance requirement

This clause contains performance requirements for the physical channels specified in [TS 36.211]. The performance requirements for the UE in this clause are specified for the measurement channels specified in Annex A.3, the propagation conditions in Annex B and the downlink channels in Annex C.3.2.

8.1 General

8.1.1 Dual-antenna receiver capability

The performance requirements are based on UE(s) that utilize a dual-antenna receiver.

8.1.1.1 Simultaneous unicast and MBMS operations

8.1.1.2 Dual-antenna receiver capability in idle mode

8.2 Demodulation of PDSCH (Cell-Specific Reference Symbols)

8.2.1 FDD (Fixed Reference Channel)

8.2.1.1 Single-antenna port performance

The receiver single-antenna performance in a given multi-path fading environments is determined by the SNR for which a certain relative information bit throughput of the reference measurement channels in Annex A.3.2 is achieved.

8.2.1.1.1 Minimum Requirement QPSK

The requirements are specified in Table 8.2.1.1.1-2, with the addition of the parameters in Table 8.2.1.1.1-1 and the downlink physical channel setup according to table [in Annex C.3.2].

Table 8.2.1.1.1-1: Test Parameters for Testing QPSK

Parameter	Unit	Test 10.1-10.3 [More columns if needed for other test setups]
Reference signal power E_{RS}/I_{or}	dB	0
N_{oc} at antenna port	dBm/15kHz	TBD [-74]
Inter-TTI Distance		1
Number of HARQ processes	Processes	8
Maximum number of HARQ transmission		4
Redundancy version coding sequence		{0,1,2,3}
Note: TBD		

Table 8.2.1.1.1-2: Minimum performance QPSK (FRC)

Bandwidth	Test Number	Reference Channel	Propagation Condition	Correlation Matrix	Reference value	
					Fraction of Maximum Throughput (%)	SNR $\hat{I}_{or}/$ (dB)
10 MHz	10.1	[F14]	EVA5	Low	70	
	10.2	[F14]	ETU70	Low	70	
	10.3	[F14]	ETU300	Low	70	
	10.4	[F44]				
	[1 PRB]					

8.2.1.1.2 Minimum Requirement 16QAM

The requirements are specified in Table 8.2.1.1.2-1, with the addition of the parameters in Table 8.2.1.1.2-2 and the downlink physical channel setup according to table [in Annex C.3.2].

Table 8.2.1.1.2-1: Test Parameters for Testing 16QAM

Parameter	Unit	Test 10.1-10.2
Reference signal power E_{RS}/I_{or}	dB	0
N_{oc} at antenna port	dBm/15kHz	TBD
Inter-TTI Distance		1
Number of HARQ processes	Processes	8
Maximum number of HARQ transmission		4
Redundancy version coding sequence		{0,1,2,3}
Note: TBD		

Table 8.2.1.1.2-2: Minimum performance 16QAM (FRC)

Bandwidth	Test Number	Reference Channel	Propagation Condition	Correlation Matrix	Reference value	
					Fraction of Maximum Throughput (%)	SNR $\hat{I}_{or}/N_{oc}$ (dB)
10 MHz	10.1	[F24]	ETU70	Low	30 70	
	10.2	[F24]	ETU300	High	70	

8.2.1.1.3 Minimum Requirement 64QAM

The requirements are specified in Table 8.2.1.1.3-2, with the addition of the parameters in Table 8.2.1.1.3-1 and the downlink physical channel setup according to table [in Annex C.3.2].

Table 8.2.1.1.3-1: Test Parameters for Testing 64QAM

Parameter	Unit	Test 10.1-10.4
Reference signal power E_{RS}/I_{or}	dB	0
N_{oc} at antenna port	dBm/15kHz	TBD
Inter-TTI Distance		1
Number of HARQ processes	Processes	8
Maximum number of HARQ transmission		4
Redundancy version coding sequence		{0,0,1,2}
Note: TBD		

Table 8.2.1.1.3-2: Minimum performance 64QAM (FRC)

Bandwidth	Test Number	Reference Channel	Propagation Condition	Correlation Matrix	Reference value	
					Fraction of Maximum Throughput (%)	SNR $\hat{I}_{or}/N_{oc}$ (dB)
10 MHz	10.1	[F34]	EVA5	Low	70	
	10.2	[F34]	ETU70	Low	70	
	10.3	[F34]	EVA5	Medium	70	
	10.4	[F34]	EVA5	High	70	

8.2.1.2 Transmit diversity performance

8.2.1.3 Open-loop spatial multiplexing performance

8.2.1.4 Closed-loop spatial multiplexing performance

8.2.1.5 MU-MIMO

8.2.1.6 [Control channel performance: D-BCH and PCH]

8.2.2 DL-SCH TDD (Fixed Reference Channel)

8.2.1.1 Single-antenna port performance

8.2.1.2 Transmit diversity performance

8.2.1.3 Open-loop spatial multiplexing performance

8.2.1.4 Closed-loop spatial multiplexing performance

8.2.1.5 MU-MIMO

8.2.1.6 [Control channel performance: D-BCH and PCH]

8.3 Demodulation of PDSCH (User-Specific Reference Symbols)

Requirements for user-specific requirements are TBD. 8.4 Demodulation of PDCCH/PCFICH

8.4.1 FDD

8.4.1.1 Single-antenna port performance

8.4.1.2 Transmit diversity performance

8.4.2 TDD

8.4.2.1 Single-antenna port performance

8.4.2.2 Transmit diversity performance

8.5 Demodulation of PHICH

8.6 Demodulation of PBCH

9 Reporting of [CQI/PMI]

<Text omitted>

Annex A (normative): Measurement channels

A.1 General

A.2 UL reference measurement channels

A.3 DL reference measurement channels

A.3.1 General

The number of available channel bits varies across the sub-frames due to PBCH and PSS/SSS overhead. The payload size per sub-frame is varied in order to keep the code rate constant throughout a frame.

The algorithm for determining the payload size A is as follows; given a desired coding rate R and radio block allocation N_{RB}

1. Calculate the number of channel bits N_{ch} that can be transmitted during the first transmission of a given sub-frame.
2. [Find A such that the resulting coding rate is as close to R as possible, that is,

   $$\min\left|R-(A+24)/N_{ch}\right|,$$

   subject to

   a) A is a valid TB size assuming an allocation of N_{RB} resource blocks]
3. If there is more than one A that minimises the equation above, then the larger value is chosen per default.

A.3.2 Reference measurement channel for receiver characteristics

Tables A.3.2-1 and A.3.2-2 are applicable for measurements on the Receiver Characteristics (clause 7) [with the exception of sub-clause 7.4 (Maximum input level)].

Tables A.3.2-1 and A.3.2-2 also apply for the modulated interferer used in Clauses 7.5, 7.6 and 7.8 with test specific bandwidths.

Table A.3.2-1 Fixed Reference Channel for Receiver Requirements (FDD)

Parameter	Unit	Value					
Nominal Avg. Inf. Bit Rate	kbps						
Number of HARQ Processes	Processes	1	1	1	1	1	1
Maximum number of HARQ transmission		1	1	1	1	1	1
Information Bit Payload per Sub-Frame	Bits						
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame	Bits						
Coding Rate							
Bandwidth	MHz	1.4	3	5	10	15	20
Number of OFDM symbols per Sub-Frame							
					11.5		
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Note 1: 2 symbols allocated to PDCCH Note 2: The RLC should be configured to Unacknowledged Mode							

Table A.3.2-2 Fixed Reference Channel for Receiver Requirements (TDD)

Parameter	Unit	Value					
Nominal Avg. Inf. Bit Rate	kbps						
Number of HARQ Processes	Processes	1	1	1	1	1	1
Maximum number of HARQ transmission		1	1	1	1	1	1
Information Bit Payload per Sub-Frame	Bits						
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame	Bits						
Coding Rate							
Bandwidth	MHz	1.4	3	5	10	15	20
Number of OFDM symbols per Sub-Frame							
					11.5		
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Note 1: 2 symbols allocated to PDCCH Note 2: The RLC should be configured to Unacknowledged Mode							

A.3.3 Reference measurement channels for PDSCH performance requirements (FDD)

A.3.3.1 Single-antenna port (Fixed Reference Channel)

Table A.3.3.1-1: Fixed Reference Channel QPSK R=1/3

Parameter		Value					
Reference Channel							
Nominal Avg. Inf. Bit Rate							
Information Bit Payload per Sub-Frame							
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame							
Coding Rate							
Bandwidth							
Number of OFDM symbols per Sub-Frame							
Modulation							

Table A.3.3.1-2: Fixed Reference Channel 16QAM R=1/2

Parameter		Value					
Reference Channel							

Nominal Avg. Inf. Bit Rate							
Information Bit Payload per Sub-Frame							
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame							
Coding Rate							
Bandwidth							
Number of OFDM symbols per Sub-Frame							
Modulation							

Table A.3.3.1-3: Fixed Reference Channel 64QAM R=3/4

Parameter	Value						
Reference Channel							
Nominal Avg. Inf. Bit Rate							
Information Bit Payload per Sub-Frame							
Number of Code Blocks							
Binary Channel Bits Per Sub-							

Frame							
Coding Rate							
Bandwidth							
Number of OFDM symbols per Sub-Frame							
Modulation							

Table A.3.3.1-4: Fixed Reference Channel Single PRB (Channel Edge)

Parameter				Value			
Reference Channel							
Nominal Avg. Inf. Bit Rate							
Information Bit Payload per Sub-Frame							
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame							
Coding Rate							
Bandwidth							
Number of OFDM symbols per Sub-Frame							

Modulation

A.3.3.2 Transmit diversity (Fixed Reference Channel)

A.3.3.3 Spatial Multiplexing (Fixed Reference Channel)

A.3.4 Reference measurement channels for PDSCH performance requirements (TDD)

A.3.4.1 Single-antenna port (Fixed Reference Channel)

Table A.3.4.1-1: Fixed Reference Channel QPSK R=1/3

Parameter	Unit	Value					
Reference Channel		[T11]	[T12]	[T13]	[T14]	[T15]	[T16]
Nominal Avg. Inf. Bit Rate	kbps						
Information Bit Payload per Sub-Frame	Bits						
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame	Bits						
Coding Rate							
Bandwidth	MHz	1.4	3	5	10	15	20
Number of OFDM symbols per Sub-Frame							
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK

Table A.3.4.1-2: Fixed Reference Channel 16QAM R=1/2

Parameter	Unit	Value					
Reference Channel		[T21]	[T22]	[T23]	[T24]	[T25]	[T26]
Nominal Avg. Inf. Bit Rate	kbps						
Information Bit Payload per Sub-Frame	Bits						
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame	Bits						
Coding Rate							
Bandwidth	MHz	1.4	3	5	10	15	20
Number of OFDM symbols per Sub-Frame							
Modulation		16QAM	16QAM	16QAM	16QAM	16QAM	16QAM

Table A.3.4.1-3: Fixed Reference Channel 64QAM R=3/4

Parameter	Unit	Value					
Reference Channel		[T31]	[T32]	[T33]	[T34]	[T35]	[T36]
Nominal Avg. Inf. Bit Rate	kbps						
Information Bit Payload per Sub-Frame	Bits						

Number of Code Blocks							
Binary Channel Bits Per Sub-Frame	Bits						
Coding Rate							
Bandwidth	MHz	1.4	3	5	10	15	20
Number of OFDM symbols per Sub-Frame							
Modulation		64QAM	64QAM	64QAM	64QAM	64QAM	64QAM

Table A.3.4.1-4: Fixed Reference Channel Single PRB

Parameter	Unit	Value					
Reference Channel		[T41]	[T42]	[T43]	[T44]	[T45]	[T46]
Nominal Avg. Inf. Bit Rate	kbps						
Information Bit Payload per Sub-Frame	Bits						
Number of Code Blocks							
Binary Channel Bits Per Sub-Frame	Bits						
Coding Rate							
Bandwidth	MHz	1.4	3	5	10	15	20
Number of OFDM symbols per Sub-Frame							
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK

A.3.4.2 Transmit diversity (Fixed Reference Channel)

A.3.4.3 Spatial multiplexing (Fixed Reference Channel)

Annex B (normative): Propagation conditions

B.1 Static propagation condition

B.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.
- A combination of channel model parameters that include the Delay profile and the Doppler spectrum, that is characterized by a classical spectrum shape and a maximum Doppler frequency
- A set of correlation matrices defining the correlation between the UE and eNodeB antennas in case of multi-antenna systems.

B.2.1 Delay profiles

The delay profiles are selected to be representative of low, medium and high delay spread environments. The resulting model parameters are defined in Table B.2.1-1 and the tapped delay line models are defined in Tables B.2.1-2, B.2.1-3 and B.2.1-4.

Table B.2.1-1 Delay profiles for E-UTRA channel models

Model	Number of channel taps	Delay spread (r.m.s.)	Maximum excess tap delay (span)
Extended Pedestrian A (EPA)	7	45 ns	410 ns
Extended Vehicular A model (EVA)	9	357 ns	2510 ns
Extended Typical Urban model (ETU)	9	991 ns	5000 ns

Table B.2.1-2 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.2.1-3 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.2.1-4 Extended Typical Urban model (ETU)

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

B.2.2 Combinations of channel model parameters

Table B.2.2-1 shows propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies

Table B.2.2-1 Channel model parameters

Model	Maximum Doppler frequency
EPA 5Hz	5 Hz
EVA 5Hz	5 Hz
EVA 70Hz	70 Hz
ETU 70Hz	70 Hz
ETU 300Hz	300 Hz

B.2.3 Multi-Antenna channel models

Table B.2.3-1 defines the correlation matrix for the eNodeB

Table B.2.3-1 eNodeB correlation matrix

	One antenna	Two antenna
eNode B Correlation	$R_{eNB} = 1$	$R_{eNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & \mathbf{1} \end{pmatrix}$

Table B.2.3-2 defines the correlation matrix for the UE:

Table B.2.3-2 UE correlation matrix

UE Correlation $$R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & \mathbf{1} \end{pmatrix}$$

Table B.2.3-3 define the channel spatial correlation matrix R_{spat}. The parameters, α and β in Table B.2.3-3 defines the spatial correlation between the antennas at the eNodeB and UE.

Table B.2. 3-3: R_{spat} correlation matrices

1x2 case

$$R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$$

2x2 case

$$R_{spat} = R_{eNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$$

The α and β for different correlation types are given in Table B.2.3-4.

Table B.2.3-4

Low correlation		Medium Correlation		High Correlation	
α	β	α	β	α	β
0	0	0.3	0.9	0.9	0.9

For cases with more antennas at either eNodeB or UE or both, the channel spatial correlation matrix can still be expressed as the Kronecker product of R_{eNB} and R_{UE} according to $R_{spat} = R_{eNB} \otimes R_{UE}$.

B.2.3 Correlation Matrix Definitions

The correlation matrices for high, medium and low correlation are defined in Table B.23-1-1, B.2.3.1-2 and B.2.3.1-3, below

Table B.2.3.1: correlation matrices for high correlation

1x2 case

$$R_{high} = \begin{pmatrix} 1 & 0.9 \\ 0.9 & 1 \end{pmatrix}$$

2x2 case

$$R_{high} = \begin{pmatrix} 1 & 0.9 & 0.9 & 0.81 \\ 0.9 & 1 & 0.81 & 0.9 \\ 0.9 & 0.81 & 1 & 0.9 \\ 0.81 & 0.9 & 0.9 & 1 \end{pmatrix}$$

Table B.2.3-2: correlation matrices for medium correlation

1x2 case **2x2 case**

N/A	$R_{medium} = \begin{pmatrix} 1 & 0.9 & 0.3 & 0.27 \\ 0.9 & 1 & 0.27 & 0.3 \\ 0.3 & 0.27 & 1 & 0.9 \\ 0.27 & 0.3 & 0.9 & 1 \end{pmatrix}$

Table B.2.3-3: correlation matrices for low correlation

1x2 case	2x2 case
$R_{low} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$	$R_{low} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

B.3 High speed train scenario

The high speed train condition for the test of the baseband performance is a non fading propagation channel with one tap. Doppler shift is given by

$$f_s(t) = f_d \cos\theta(t)$$

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

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

where $D_s/2$ is the initial distance of the train from eNodeB, and $D_{\min}$ is eNodeB Railway track distance, both in meters; v is the velocity of the train in m/s, t is time in seconds. The parameters in the equation are shown in Table B.3-1 assuming a carrier frequency f_C = 2690 MHz. The resulting Doppler shift is shown in Figure.B.3-1.

Table B.3-1: High speed train scenario

Parameter	Value
D_s	300 m
$D_{\min}$	2 m
v	300 km/h
f_d	750 Hz

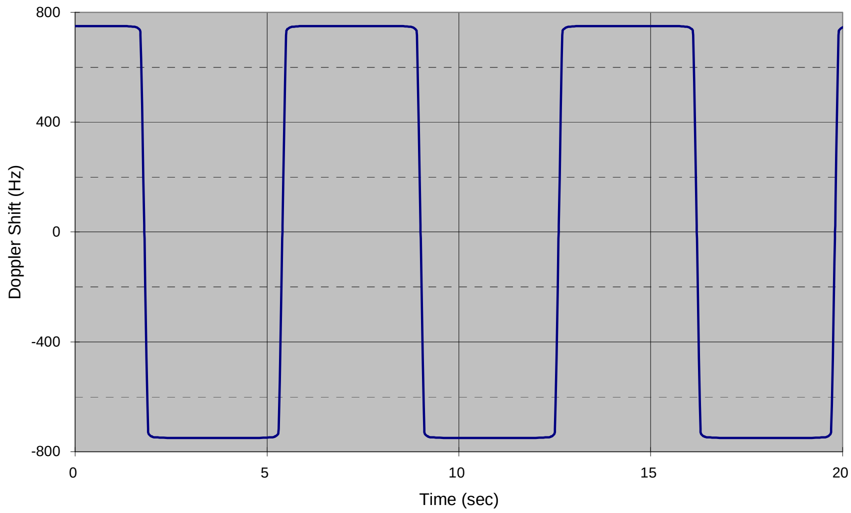

Figure B.3-1: Doppler shift trajectory

Annex C (normative): Downlink Physical Channels

C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

C.2 Set-up

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required for connection set-up

Physical Channel
PBCH
SSS
PSS
PCFICH
PDCCH
PHICH
PDSCH

C.3 Connection

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.3.1 Measurement of Receiver Characteristics

Table C.3.1-1 is applicable for measurements on the Receiver Characteristics (clause 7).

Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

Physical Channel	EPRE Ratio	
PBCH	PBCH_RA = 0 dB	
	PBCH_RB = 0 dB	
PSS	PSS_RB = 0 dB	
SSS	SSS_RB = 0 dB	
PCFICH	PCFICH_RA = 0 dB	
PDCCH	PDCCH_RA = 0 dB	
	PDCCH_RB = 0 dB	
PDSCH	PDSCH_RA = 0 dB	
	PDSCH_RB = 0 dB	

NOTE 1: No boosting is applied.

Table C.3.1-2: Power allocation for OFDM symbols and reference signals

Parameter	Unit	Value	Note
Transmitted power spectral density I_{or}	dBm/15 kHz	Test specific	1. I_{or} shall be kept constant throughout all OFDM symbols
Cell-specific reference signal power ratio E_{RS} / I_{or}		0 dB	

C.3.2 Measurement of Performance requirements

Table C.3.2-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels.

Table C.3.2-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

Physical Channel	EPRE Ratio	
PBCH	PBCH_RA = ρ_A	
	PBCH_RB = ρ_B	
PSS	PSS_RB = ρ_B	
SSS	SSS_RB = ρ_B	
PCFICH	PCFICH_RA = ρ_A	
PDCCH	PDCCH_RA = ρ_A	
	PDCCH_RB = ρ_B	
PDSCH	PDSCH_RA = ρ_A	
	PDSCH_RB = ρ_B	

NOTE 1: $\rho_A = \rho_B$ = 0 dB means no RS boosting.

Table C.3.2-2: Power allocation for OFDM symbols and reference signals

Parameter	Unit	Value	Note
Total transmitted power spectral density I_{or}	dBm/15 kHz	Test specific	1. I_{or} shall be kept constant throughout all OFDM symbols
Cell-specific reference signal power ratio E_{RS} / I_{or}		Test specific	1. Applies for antenna port *p*

Annex D (normative): Characteristics of the interfering signal

D.1 General

When the channel band width is wider or equal to 5MHz, a modulated 5MHz full band width E-UTRA down link signal and CW signal are used as interfering signals when RF performance requirements for E-UTRA UE receiver are defined. For channel band widths below 5MHz, the band width of modulated interferer should be equal to band width of the received signal.

D.2 Interference signals

Table D.2-1 describes the modulated interferer for different channel band width options.

Table D.2-1: Description of modulated E-UTRA interferer

	Channel bandwidth					
	1.4 MHz	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
RB	6	15	25	50	75	100
$BW_{Interferer}$	1.4 MHz	3 MHz	5 MHz	5 MHz	5 MHz	5 MHz

Annex E (normative): Environmental conditions

E.1 General

This normative annex specifies the environmental requirements of the UE. Within these limits the requirements of the present documents shall be fulfilled.

E.2 Environmental

The requirements in this clause apply to all types of UE(s).

E.2.1 Temperature

The UE shall fulfil all the requirements in the full temperature range of:

Table E.2.1-1

+15°C to +35°C	for normal conditions (with relative humidity of 25 % to 75 %)
-10°C to +55°C	for extreme conditions (see IEC publications 68-2-1 and 68-2-2)

Outside this temperature range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 for extreme operation.

E.2.2 Voltage

The UE shall fulfil all the requirements in the full voltage range, i.e. the voltage range between the extreme voltages.

The manufacturer shall declare the lower and higher extreme voltages and the approximate shutdown voltage. For the equipment that can be operated from one or more of the power sources listed below, the lower extreme voltage shall not be higher, and the higher extreme voltage shall not be lower than that specified below.

Table E.2.2-1

Power source	Lower extreme voltage	Higher extreme voltage	Normal conditions voltage
AC mains	0,9 * nominal	1,1 * nominal	nominal
Regulated lead acid battery	0,9 * nominal	1,3 * nominal	1,1 * nominal
Non regulated batteries: Leclanché Lithium Mercury/nickel & cadmium	 0,85 * nominal 0,95 * nominal 0,90 * nominal	 Nominal 1,1 * Nominal	 Nominal 1,1 * Nominal Nominal

Outside this voltage range the UE if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in clause 6.2 for extreme operation. In particular, the UE shall inhibit all RF transmissions when the power supply voltage is below the manufacturer declared shutdown voltage.

E.2.3 Vibration

The UE shall fulfil all the requirements when vibrated at the following frequency/amplitudes.

Table E.2.3-1

Frequency	ASD (Acceleration Spectral Density) random vibration
5 Hz to 20 Hz	0,96 m^2/s^3
20 Hz to 500 Hz	0,96 m^2/s^3 at 20 Hz, thereafter –3 dB/Octave

Outside the specified frequency range the UE, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the UE exceed the transmitted levels as defined in TS 36.101 for extreme operation.

Annex F (normative): Transmit modulation

F.1 Measurement Point

The unwanted emission falling into non-allocated RB(s) is calculated directly after the FFT as described below. In contrast to this, the EVM for the allocated RB(s) is calculated after the IDFT.

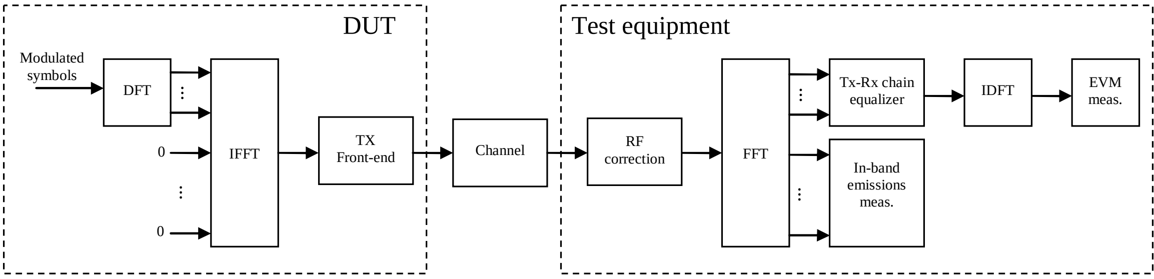

Figure F.1-1: EVM measurement points

F.2 Basic Error Vector Magnitude measurement

The EVM is the difference between the ideal waveform and the measured waveform for the allocated RB(s)

$$EVM = \sqrt{\frac{\sum_{v \in T_m} \left| z'(v) - i(v) \right|^2}{\left| T_m \right| \cdot P_0}},$$

where

T_m is a set of $|T_m|$ modulation symbols with the considered modulation scheme being active within the measurement period,

$z'(v)$ are the samples of the signal evaluated for the EVM,

$i(v)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

The basic EVM measurement interval is defined over one subframe in the time domain.

F.3 Basic in-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks

For the non-allocated RBs below the allocated frequency block the in-band emissions would be measured as follows

$$Emissions_{absolute}(\Delta_{RB}) = \frac{1}{|T_s|}\sum_{t\in T_s}\sum_{\max(f_{\min},c-12\cdot\Delta_{RB})}^{\min(f_{\max},c-12\cdot\Delta_{RB}+11)}|Y(t,f)|^2,$$

where

T_s is a set of $|T_s|$ SC-FDMA symbols with the considered modulation scheme being active within the measurement period,

Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB),

$f_{\min}$ (resp. $f_{\max}$) is the lower (resp. upper) edge of the UL system BW,

c is the lower edge of the allocated BW, and

$Y(t,f)$ is the frequency domain signal evaluated for in-band emissions as defined in the subsection (ii)

The relative in-band emissions are, given by

$$Emissions_{relative}(\Delta_{RB}) = \frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_s|\cdot N_{RB}}\sum_{t\in T_s}\sum_{c}^{c+12\cdot N_{RB}-1}|Y(t,f)|^2}$$

where

N_{RB} is the number of allocated RBs

The basic in-band emissions measurement interval is defined over one subframe in the time.

F.4 Modified signal under test

To minimize the error, the signal under test should be modified with respect to a set of parameters following the procedure explained below.

Notation:

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

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

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

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

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

The EVM analyser shall

- detect the start of each subframe and estimate $\Delta\tilde{t}$ and $\Delta\tilde{f}$,

- determine $\Delta\tilde{c}$ so that the EVM window of length W is centred on the measured cyclic prefix of the considered OFDM symbol.

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

- correct the RF frequency offset $\Delta\tilde{f}$ for each subframe, and
- apply an FFT of appropriate size.

The IQ origin offset shall be removed from the evaluated signal before calculating the EVM and the in-band emissions; however, the removed relative IQ origin offset power (relative carrier leakage power) also has to satisfy the applicable requirement.

At this stage the allocated RBs shall be separated from the non-allocated RBs. The signal on the non-allocated RB(s), $Y(t, f)$, is used to evaluate the in-band emissions.

Moreover, the following procedure applies only to the signal on the allocated RB(s). The UL EVM analyzer shall then estimate the TX chain equalizer coefficients $\tilde{a}(t, f)$ and $\tilde{\varphi}(t, f)$ used by the ZF equalizer for all subcarriers by

1. time averaging at each reference signal subcarrier of the amplitude and phase of the reference symbols, the time-averaging length is [1] subframe. This process creates an average amplitude and phase for each reference signal subcarrier.

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

- calculate EVM_l with $\Delta\tilde{t}$ set to $\Delta\tilde{c} + \alpha - \left\lfloor \frac{W}{2} \right\rfloor$,
- calculate EVM_h with $\Delta\tilde{t}$ set to $\Delta\tilde{c} + \left\lfloor \frac{W}{2} \right\rfloor$.

F.5 Window length

F.5.1 Timing offset

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

F.5.2 Window length

The window length W affects the measured EVM, and is expressed as a function of the configured cyclic prefix length. In the case where equalization is present, as with frequency domain EVM computation, the effect of FIR is reduced. This is because the equalization can correct most of the linear distortion introduced by the FIR. However, the time domain windowing effect can"t be removed.

F.5.3 Window length for normal CP

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

Table F.5-1 EVM window length for normal CP

Channel Bandwidth MHz	Cyclic prefix length N_{cp} for symbol 0	Cyclic prefix length N_{cp} for symbols 1 to 6	Nominal FFT size	Cyclic prefix for symbols 1 to 6 in FFT samples	EVM window length W	Ratio of W to CP for symbols 1 to 6*
1.4	160	144	128	9	[7]	[77.8]
3			256	18	[14]	[77.8]
5			512	36	[32]	[88.9]
10			1024	72	[66]	[91.7]
15			1536	108	[102]	[94.4]
20			2048	144	[136]	[94.4]

* Note: These percentages are informative and apply to symbols 1 through 6. Symbol 0 has a longer CP and therefore a lower percentage.

F.5.4 Window length for Extended CP

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

Table F.5-2 EVM window length for extended CP

Channel Bandwidth MHz	Cyclic prefix length N_{cp}	Nominal FFT size	Cyclic prefix in FFT samples	EVM window length W	Ratio of W to CP*
1.4	512	128	32	[30]	[93.8]
3		256	64	[60]	[93.8]
5		512	128	[124]	[96.9]
10		1024	256	[250]	[97.4]
15		1536	384	[374]	[97.4]
20		2048	512	[504]	[98.4]

* Note: These percentages are informative

F.6 Averaged EVM

EVM is averaged over all basic EVM measurements for 10 consecutive subframes.

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

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

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

Thus we get:

$$EVM = \max(\overline{\mathrm{EVM}}_{\mathrm{l}}, \overline{\mathrm{EVM}}_{h})$$

F.7 Spectrum Flatness

The data for the subcarrier output power shall be taken from the equaliser estimation step.

Annex G (informative): Change history

Table G.1: Change History

Date	TSG#	TSG Doc.	CR	Subject	Old	New
9-11-2007	R4#45	R4-72206		TS36.101V0.1.0 approved by RAN4	-	
12-2007	RP#38	RP-070979		Approved version at TSG RAN #38	1.0.0	8.0.0
03-2008	RP#39	RP-080123	3	TS36.101 - Combined updates of E-UTRA UE requirements	8.0.0	8.1.0
05-2008	RP#40	RP-080325	4	TS36.101 - Combined updates of E-UTRA UE requirements	8.1.0	8.2.0

History

Document history		
V8.2.0	November 2008	Publication