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UTRA (BS) FDD; Radio transmission and reception

3GPP

Contents

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Foreword

This ETSI Technical Report (TR) has been produced by ETSI Special Mobile Group (SMG) of the European Telecommunications Standards Institute (ETSI). This report has been elaborated by the Layer 1 expert group of SMG2 "Radio aspects", as a part of the work in defining and describing Layer 1 of the Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (UTRA).
This report describes the radio transmission and reception parameters in UTRA/FDD.

1 Scope

This document establishes the minimum RF characteristics of the FDD mode of UTRA. The main objectives of the document are to be a part of the full description of the UTRA Layer 1, and to serve as a basis for the drafting of the technical specification (TS).

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, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] Reference 1

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Power Setting - The value of the control signal, which determines the desired transmitter, output Power. Typically, the power setting would be altered in response to power control commands

Maximum Power Setting - The highest value of the Power control setting which can be used.

Maximum output Power This refers to the measure of power when averaged over the transmit timeslot at the maximum power setting.

Peak Power - The instantaneous power of the RF envelope which is not expected to be exceeded for [99.9%] of the time.

Maximum peak power - The peak power observed when operating at a given maximum output power.

Average Power - The average transmitter output power obtained over any specified time interval, including periods with no transmission. *<Editors: This definition would be relevant when considering realistic deployment scenarios where the power control setting may vary. >*

Maximum average power The average transmitter output power obtained over any specified time interval, including periods with no transmission, when the transmit time slots are at the maximum power setting. *<Editors: The average power at the maximum power setting would also be consistent with defining a long term average power>*

3.2 Symbols

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

<symbol> <Explanation>

3.3 Abbreviations

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

ACPR	Adjacent Channel Power Ratio
ACS	Adjacent Channel Selectivity
BER	Bit Error Rate
BS	Base Station
CW	Continuous wave (unmodulated signal)
DL	Down link (forward link)
EIRP	Equivalent Isotropic Radiated Power
FDD	Frequency Division Duplexing
FER	Frame Error Rate
PPM	Parts Per Million
RSSI	Received Signal Strength Indicator
SIR	Signal to Interference ratio
TDD	Time Division Duplexing

TPC	Transmit Power Control
UE	User Equipment
UL	Up link (reverse link)
UTRA	UMTS Terrestrial Radio Access

4 Status

The main objective of this section is to provide summary of the approval status of the various section of this document. The level of progress is defined as follows;

- No proposal exists
- A proposal(s) exists but no working assumption has been made
- A working assumption has been taken and the text contained in that section may have been update in line with that assumption
- This section is assumed to be finalised.

Reference should be made to the current XX18 (status and study document) for other open issues. Unless stated otherwise only the agreed working assumptions are indicated below.

Section number	**Section description**	**Status**
5.2	Frequency band	Working assumption
5.3	TX-RX frequency separation	Working assumption is based on fixed separation of 130 MHz between the specified RX and TX band A proposal exists to support a variable duplexer distance. The specific limits are yet to be determined.
5.4.2	Channel raster	Working assumption channel raster = 200 kHz
6.2.1	UE output power	A working assumption is than one UE power class should be +21 dBm
7.2	Diversity characteristics	Working assumption is there are three forms of diversity; time, frequency and space

5 Frequency bands and channel arrangement

This section will be identical to Section 5 of S4.01A on “Frequency bands and Channel arrangement”.

5A Base station classes

The requirements in this specification apply to base station intended for general-purpose applications.

In the future further classes of base stations may be defined; the requirements for these may be different than for general-purpose applications.

6 Transmitter characteristics

6.1 General

Unless detailed the transmitter characteristic are specified at the antenna connector..

6.2 Base station output power

Total power is the mean power delivered to a load with resistance equal to the nominal load impedance of the transmitter.

6.2.1 Minimum requirement

The total power shall remain within +TBD dB and –TBD dB of the manufacturer's rated power.

6.3 Frequency stability

Frequency stability is ability of the BS to transmit at the assigned carrier frequency.

6.3.1 Minimum requirement

The frequency stability of the BS shall be accurate to within ± [0.05] PPM for RF frequency generation.

6.4 Output power dynamics

Power control is used to limit the interference level. The transmitter uses a quality-based power control on both the uplink and downlink.

6.4.1 Closed loop power control

Closed loop power control is the ability of the BS transmitter to adjust its output power in response to the UL/DL received signal.

For closed loop correction on the Downlink Traffic Channel (with respect to the open loop estimate), the base station adjust its mean output power level in response to each valid power control bit received from MS on the Reverse Traffic Channel.

6.4.2 Power control steps

The power control step is the minimum step change in the DL transmitter output power in response to a TPC message from the UE.

6.4.2.1 Minimum requirement

Down link step size	[1 dB]
Step size tolerance	ffs.

<Need to define the transmitter power as "code domain power". This is ffs.>

6.4.3 Power control dynamic range

The power control dynamic range is difference between the maximum and the minimum transmit output power of a traffic channel for a specified reference condition.

6.4.3.1 Minimum requirements

Down link (DL) power control dynamic range [25 dB]
<Definition needs clarification. 25 dB is relative to Pmax – 3 dB.>

6.4.4 Minimum transmit power

The minimum controlled output power of the BS is when the power control setting is set to a minimum value. This is when the power control indicates a minimum transmit output power is required

6.4.4.1 Minimum requirement

Down link (DL) minimum transmit power [Maximum output power – 18 dB]
<The maximum output power definition is ffs.>

6.4.5 Total power dynamic range

The power control dynamic range is difference between the maximum and the minimum transmit output power for a specified reference condition

6.4.5.1 Minimum requirement

Down link (DL) total power dynamic range 18 dB
<This requirement is redundant, since 6.4.4 defines the same dynamic range by a minimum transmit power.>

6.4.6 Power control cycles per second

The maximum rate of change for the DL transmitter power control step.

The Down link (DL) rate of power control steps is 1.6 kHz.

6.4.7 Perch channel power

The perch channel power, sum of the 1st and 2nd perch channel power, to total power ratio is the power attributed perch channel divided by the total power, and is expressed in dB. The 2nd perch channel power is the averaged power during one frame.

6.4.7.1 Minimum requirement

Each perch channel power to total power ratio is shall be within ±**TBD** dB of the configured value.
<The name of the perch channel may need to be changed, subject to WG1 definition.>

6.6 Output RF spectrum emissions

6.6.1 Occupied bandwidth

Occupied bandwidth is a measure of the bandwidth containing 99% of the total integrated power for transmitted spectrum and is centered on the assigned channel frequency. The occupied channel bandwidth is less than 5 MHz based on a chip rate of 4.096 Mcps.

<Needs to be reviewed for the conformance specification.>

6.6.2 Out of band emission

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. This out of band emission limit can be specified in terms of a spectrum emission mask or adjacent channel power ratio for the transmitter.

6.6.2.1 Spectrum emission mask

The emission mask of the base station is an item for further study.

6.6.2.2 Adjacent channel power ratio (ACPR)

Adjacent channel power ratio (ACPR) is the ratio of the transmitted power from one carrier within a reference bandwidth of [4.096 MHz] to the power measured within a reference bandwidth of [4.096 MHz] centered on the adjacent(s) channel(s).

6.6.2.2.1 Minimum requirement

BS channel	ACPR limit
± First adjacent channel	[ ] dBc
± Second adjacent channel	[ ] dBc

Table 4, BS ACPR

Note
In order to ensure that switching transients due to the slotted mode do not degrade the ACPR value the reference measurements conditions are an item for further study.

6.6.3 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. This is measured at the base station RF output port.

The frequency boundary and the detailed transitions of the limits between the requirement for out band emissions and spectrum emissions is an item for further study. Guidance can be taken from the applicable tables from ITU-R Recommendations SM.329, ERC Recommendations and regulatory input from other regions.

6.6.3.1 Minimum requirement

<From ARIB Vol. 5; Section 6.1.1.4; Note: This ARIB content partly maps also on XX.06 sections 6.6.1 and 6.6.2, because of somewhat different definitions of spurious emissions>

The spurious emission level against the mean output power of the base station in the Transmission band shall not exceed the limits specified below.

In the (a) Concerned Operator's System Bands and the (b) Other Bands Within Cellular Band,
the spurious emission level within a [**]kHz bandwidth shall not exceed a level Specified
in the Table 6.1.1.4-2. In the (c) Other Bands, the spurious emission level within a 1MHz bandwidth shall not exceed a level specified in the Table 6.1.1.4-2. Each transmission band
is defined as follows:

Concerned Operator's System Bands: The bands of the concerned operator's system used for this CDMA system.
Other Bands Within Cellular Band: The 2.0G-band including other operator's cellular system bands, but excluding the (a) Concerned Operator's System Bands.
Other Bands: Other bands entirely consisting of all frequencies, but excluding the above bands (a) and (b).

Table 6.1.1.4-2. Spurious Emission Limits When Transmitting.

Measurement Band	Maximum Spurious Emission Level
Concerned Operator's System Bands	Shown the Adjacent channel leakage power in 6.1.1.3
Other Bands Within Cellular Band	-[**]dB/[**]kHz or [**] μW(-[**]dBm)/[**]kHz, whichever the level is smaller.
Other Bands	If the mean transmission power is no more than 25W: [25μW(-16dBm)/1MHz or less.] If the mean transmission power is more than 25W: [-60dBc/1MHz or less, and 20mW(+13dBm)/1MHz or less.]

	[current rules in each country shall apply.]

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.

6.7.2 BS intermodulation attenuation

The transmit intermodulation shall be defined by the ratio of the output power of subject transmitted signal to the output power of intermodulation product when an interference signal (that differs from frequency of subject signal) is added at a level [**]dB lower than that of the subject signal. The frequency of the interference signal shall be [**]MHz or more off the subject signal, however, as for interference signal whose frequency is in the range of 5MHz to 10MHz off the subject signal, adjacent channel leakage power is used instead of the output of intermodulation product.

6.7.2.1 Minimum requirement

The Transmit intermodulation level against the mean output power per carrier of the base station shall not exceed the limits specified below.

[If the mean transmission power is no more than 25W : 25μW(-16dBm) / 1MHz or less.]
[If the mean transmission power is more than 25W : -60dBc/1MHz or less, and 20mW (+13dBm) / 1MHz or less.]
<This is based on ARIB input. Further input for co-located cellular systems is needed.>

6.8 Modulation Accuracy

Modulation accuracy is the difference between the measured and the theoretical modulated waveform. Modulation accuracy is measured as the root-mean-square value of the error of the vector of the ideal signal point.

6.8.1 Minimum requirement

The Modulation accuracy shall not be worse than [12.5] %.

7 Receiver characteristics

7.1 General

Unless detailed the receiver characteristic are specified at each antenna connector of the BS.

<Definition of requirements for antenna diversity is ffs.>

7.3 Reference sensitivity level

The reference sensitivity is the minimum receiver input power measured at the antenna connector at which the FER/BER does not exceed the specific value indicated in section 7.3.1. The signal power is equally applied to each antenna connector for diversity.

7.3.1 BS reference sensitivity level

For the different services with corresponding data rates, the reference sensitivity level of the BS shall be specified in table 8 below.

Data rate	BS reference sensitivity level (dBm)	[FER/BER]

Table 8, BS reference sensitivity levels

7.3.2 Maximum Frequency Deviation for Receiver Performance

The need for such a requirement is for further study.

7.4 Dynamic range

The receiver dynamic range is the input power range at each BS antenna connector over which the [FER/BER} does not exceed a specific rate.

The static [BER/FER] reference performance as specified in clause 7.3.1 should be met over a receiver input range of [30] dB above the specified reference sensitivity level for [channel type ffs].

<The effect of applying mast head LNAs to the dynamic range specification is ffs.>

7.5 Adjacent channel selectivity

Adjacent channel selectivity (ACS) is a measure of the receiver ability to receive a wanted signal at is assigned channel frequency in the presence of a modulated signal in the adjacent channel

The static reference performance as specified in clause 7.3.1 should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- A modulated interfering adjacent channel signal with a level of [ ] dBm.

7.6 Blocking characteristics

The blocking characteristics is a measure of the receiver ability to receive a wanted signal at is 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.

The static reference performance as specified in clause 7.3.1 should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- An interfering signal at [frequency(s)] offset from the nominal assigned channel below a level of [ ] dBm.

< Editor: The frequency range (in band/out of band) and level of the interfering signal is an item for further study>
<The definition of the exemptions needs to be reconsidered, since it is unclear.>

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 blocking limit is not met.

The static reference performance as specified in clause 7.3.1 should be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- A CW interfering signal below a level of [ ] dBm.
- The number of allowed spurious responses is an item for further study.

7.8 Intermodulation characteristics

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 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.

The static reference performance as specified in clause 7.3.1 ashould be met when the following signals are applied to the receiver;

- A wanted signal at the assigned channel frequency, 3 dB above the static reference level.
- A CW interfering signal at frequency [10 MHz] and a [CW] signal at frequency [20.1 MHz] with a level of [ ] dBm.

7.9 Spurious emissions

<Text to be added.>

8 Performance requirement

8.1 General

Performance requirements are specified for a number of test environments and multi-path channel classes.

8.2 BS Dynamic reference sensitivity performance

The minimum required dynamic reference sensitivity performance is specified according to the traffic rate and the propagation conditions.

8.2.1 Performance in AWGN channel

The performance requirement in AWGN channel is determined by the E_b/I_0 required for BER=10^{-3}, 10^{-6}. The BER is calculated for each of the possible data services.

8.2.1.2 Single link performance

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Data rates (kbps)	Required E_b/I_0
Speech (10^{-3})	8	T.B.D.
Long Constrained Delay data bearer services (10^{-6})	64 2048	T.B.D. T.B.D.
Unconstrained Delay Data bearer services (10^{-6})	64 2048	T.B.D. T.B.D.

[6.4.1.3 Uplink power control]

[The uplink power control test ensures that the power control bits have the correct sense, position, delay, and amplitude.]

[6.4.1.4 Softer handover performance]

[Further study]

[6.4.1.5 Soft handover performance]

[Further study]

8.2.2 Performance in multipath fading channels

The performance requirement of reverse link with/without TPC in multipath fading channels is determined by the E_b/I_0 required for BER=10^{-3}, 10^{-6}. The BER is calculated for each of the possible data services.

8.2.2.1 Single link performance

8.2.2.1.1 Performance without TPC

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Indoor (A), 3km/h		Pedestrian (A), 3km/h		Vehicular (A), 120km/h	
	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0
Speech (10^{-3})	8kbps	T.B.D.	8kbps	T.B.D.	8kbps	T.B.D.
Long Constrained Delay data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.
Unconstrained Delay Data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.

8.2.2.1.2 Performance with TPC

The required E_b/I_0 is described in Table XXX.

Table XXX E_b/I_0 required for BER=10^{-3}, 10^{-6}

Data services (BER)	Indoor (A), 3km/h		Pedestrian (A), 3km/h		Vehicular (A), 120km/h	
	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0	Data rates	Required E_b/I_0
Speech (10^{-3})	8kbps	T.B.D.	8kbps	T.B.D.	8kbps	T.B.D.
Long Constrained Delay data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.
Unconstrained Delay Data bearer services (10^{-6})	64kbps 2048kbps	T.B.D. T.B.D.	64kbps 384kbps	T.B.D. T.B.D.	64kbps 144kbps 384kbps	T.B.D. T.B.D. T.B.D.

[6.4.2.3 Uplink power control]

[The uplink power control test ensures that the power control bits have the correct sense, position, delay, and amplitude.]

[6.4.2.4 Softer handover performance]

[Further study]

[6.4.2.5 Soft handover performance]

[Further study]

Annex A (normative): Transmit power levels versus time

Annex B (normative): Propagation conditions

Annex C (normative): Environmental conditions

History

Document history		
V0.0.1	1999-02-05	Merged document from (ARIB) Specification of Base Station for 3G Mobile System ver 1.0-0.1 and (ETSI) XX06v0.4.01 UTRA FDD; Radio transmission and reception (base station relevant parts).
V0.0.2	1999-02-16	Output from WG4 drafting session, with single base line text for most sections.
V0.0.3	1999-02-24	Editorial update after WG4#2 for distribution on the e-mail reflector.

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