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Technical Specification

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Foreword

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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1 Scope

The present document establishes the minimum radio frequency performance of UTRA repeaters.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Down-link	Signal path where base station transmits and mobile receives.
Operating band	The frequency range that the repeater operates in with operational configuration. This frequency range can correspond to one or several consecutive nominal 5 MHz channels. If they are not consecutive each subset of channels shall be considered as an individual band.
Repeater	A device that receives, amplifies and transmits the radiated or conducted RF carrier both in the down-link direction (from the base station to the mobile area) and in the up-link direction (from the mobile to the base station)
Up-link	Signal path where mobile transmits and base station receives.

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:

EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FFS	For Further Study
IMT2000	International Mobile Telecommunication-2000
ITU	International Telecommunication Union
RF	Radio Frequency
UARFCN	UTRA Absolute Radio Frequency Channel Number
UMTS	Universal Mobile Telecommunication System

UTRA	Universal Terrestrial Radio Access
WCDMA	Wide band Code Division Multiple Access

4 General

Unless otherwise stated, all requirements in this specification apply to both the up-link and down-link directions.

5 Frequency bands and channel arrangement

5.1 Frequency bands

A UTRA/FDD Repeater is designed to operate in one or several operating bands within either of the following paired frequency bands;

(a) 1920 – 1980 MHz: Up-link (Mobile transmit, base receive)
2110 – 2170 MHz: Down-link (Base transmit, mobile receive)

(b) 1850 – 1910 MHz: Up-link (Mobile transmit, base receive)
1930 – 1990 MHz: Down-link (Base transmit, mobile receive)
(Note 1)

NOTE 1: Used in Region 2. Additional allocations in ITU region 2 are FFS.

NOTE 2: Deployment in other frequency bands is not precluded.

5.2 Up-link to down-link frequency separation

(a) The minimum up-link to down-link frequency separation is 134.8 MHz and the maximum value is 245.2 MHz and all UTRA/FDD repeaters shall support a up-link to down-link frequency separation of 190 MHz when operating in the paired frequency band defined in sub-clause 5.1(a).

(b) A UTRA/FDD repeater can support both fixed and variable up-link to down-link frequency separation.

(c) When operating in the paired frequency band defined in sub-clause 5.1(b), all UTRA/FDD repeaters shall support an up-link to down-link frequency separation of 80 MHz.

(d) The use of other up-link to down-link frequency separations in existing or other frequency bands shall not be precluded.

5.3 Channel arrangement

5.3.1 Channel spacing

The nominal channel spacing is 5 MHz, but this can be adjusted to optimise performance in a particular deployment scenario.

5.3.2 Channel raster

The channel raster is 200 kHz, which means that the centre frequency must be an integer multiple of 200 kHz.

5.3.3 Channel number

The carrier frequency is designated by the UTRA Absolute Radio Frequency Channel Number (UARFCN). The value of the UARFCN in the IMT2000 band is defined as follows:

Table 5.1: UTRA Absolute Radio Frequency Channel Number

Up-link	$N_u = 5 * (F_{uplink}$ MHz)	0.0 MHz $\leq F_{uplink} \leq$ 3276.6 MHz where F_{uplink} is the up-link frequency in MHz
Down-link	$N_d = 5 * (F_{downlink}$ MHz)	0.0 MHz $\leq F_{downlink} \leq$ 3276.6 MHz where $F_{downlink}$ is the down-link frequency in MHz

6 Transmitter characteristics

6.1 Frequency stability

Frequency stability is the ability to maintain the same frequency on the output signal with respect to the input signal.

6.1.1 Minimum requirement

The frequency deviation of the output signal with respect to the input signal shall be no more than ±[0.05] ppm.

6.2 Out of band gain

This section applies only to UTRA/FDD repeaters.

Out of band gain refers to the gain of the repeater immediately outside the operating band.

6.2.1 Minimum requirement

The requirement shall be met by a repeater operating at maximum gain. The gain outside the operating band shall not exceed the maximum level specified in table 6.1, in the frequency range from f_offset = 2.7 MHz to f_offset_{max} from the first or last 5 MHz channel centre frequency, where:

- f_offset is the distance from the centre frequency of the first or last 5 MHz channel within the operating band.
- f_offset_{max} is either 12.5 MHz or the offset to the UTRA band edge at both up- and down-link as defined in section 5.1, whichever is the greater.

Table 6.1: Out of band gain limits

Frequency offset from the carrier frequency, f_offset	Maximum level
2.7 ≤ f_offset < 3.5 MHz	[TBD] dB
3.5 ≤ f < 7.5 MHz	[TBD] dB
7.5 ≤ f_offset ≤ f_offset_{max} MHz	[TBD] dB

6.3 Unwanted emission

This section applies only to UTRA/FDD repeaters.

6.3.1 Out of band emission

Out of band emissions are unwanted emissions immediately outside the operating band resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission requirement is specified in terms of a spectrum emission mask.

6.3.1.1 Spectrum emission mask

The mask defined in tables 6.2 to 6.5 below may be mandatory in certain regions. In other regions this mask may not be applied.

For regions where this clause applies, the requirement shall be met by a repeater's RF-signal output at maximum gain with WCDMA signals in the operating band of the repeater, at levels that produce the maximum rated output power per channel. Emissions shall not exceed the maximum level specified in tables 6.2 to 6.5 for the appropriate repeater maximum output power, in the frequency range from Δf = 2.5 MHz to f_offset_{max} from the 5 MHz channel, where:

- Δf is the separation between the centre frequency of first or last 5 MHz channel used in the operating band and the nominal –3 dB point of the measuring filter closest to the carrier frequency.

- f_offset is the separation between the centre frequency of first or last 5 MHz channel in the operating band and the centre of the measuring filter.

- f_offset_{max} is either 12.5 MHz or the offset to the UTRA band edge at both up- and down-link as defined in section 5.1, whichever is the greater.

NOTE 1: If the operating band corresponds to three or more consecutive nominal 5 MHz channels, the requirement shall be met with WCDMA modulated signals in the channels corresponding to:
- the first and third channel in the operating band when measuring the out of band emission below the operating band.
- the last and third last channel in the operating band when measuring the out of band emission above the operating band.

Figure 6.1: Illustrative diagram of spectrum emission mask

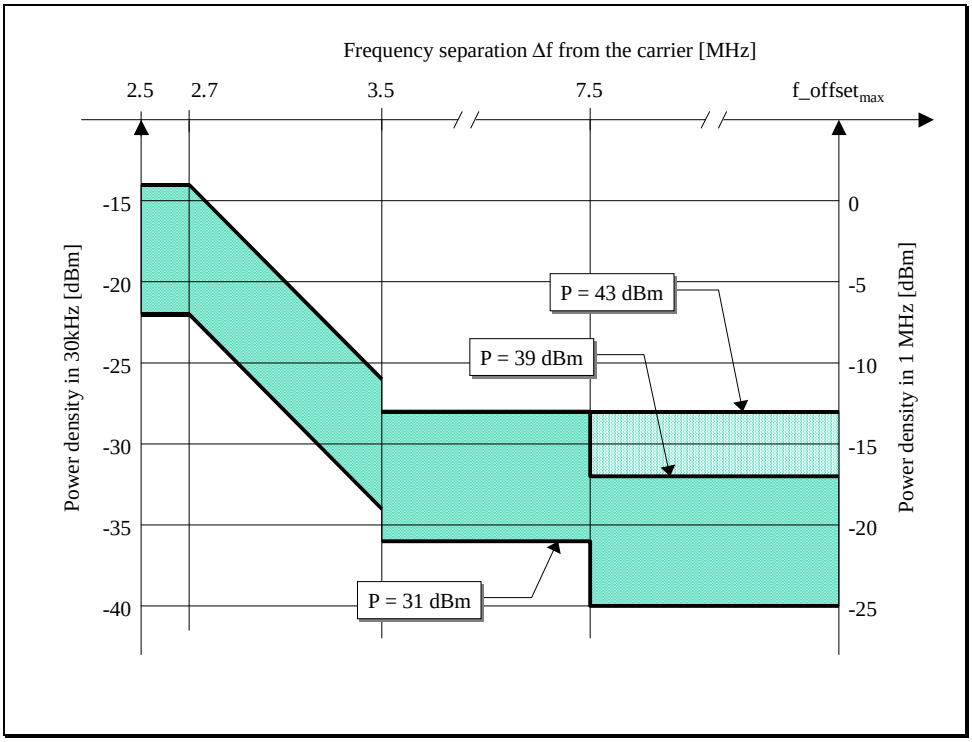

Table 6.2: Spectrum emission mask values, maximum output power P ≥ 43 dBm

Frequency offset of measurement filter – 3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Maximum level	Measurement bandwidth
2.5 ≤ Δf < 2.7 MHz	2.515MHz ≤ f_offset < 2.715MHz	[-14] dBm	30 kHz
2.7 ≤ Δf < 3.5 MHz	2.715MHz ≤ f_offset < 3.515MHz	[- 14 - 15·(f_offset- 2.715)] dBm	30 kHz
	3.515MHz ≤ f_offset < 4.0MHz	[-26] dBm	30 kHz
3.5 ≤ Δf MHz	4.0MHz ≤ f_offset < f_offset_{max}	[-13] dBm	1 MHz

Table 6.3: Spectrum emission mask values, maximum output power 39 ≤ P < 43 dBm

Frequency offset of measurement filter – 3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Maximum level	Measurement bandwidth
2.5 ≤ Δf < 2.7 MHz	2.515MHz ≤ f_offset < 2.715MHz	[-14] dBm	30 kHz
2.7 ≤ Δf < 3.5 MHz	2.715MHz ≤ f_offset < 3.515MHz	[-14 - 15·(f_offset - 2.715)] dBm	30 kHz
(see note)	3.515MHz ≤ f_offset < 4.0MHz	[-26] dBm	30 kHz
3.5 ≤ Δf < 7.5 MHz	4.0MHz ≤ f_offset < 8.0MHz	[-13] dBm	1 MHz
7.5 ≤ Δf MHz	8.0MHz ≤ f_offset < f_offset_{max}	[P - 56] dBm	1 MHz

Table 6.4: Spectrum emission mask values, maximum output power 31 ≤ P < 39 dBm

Frequency offset of measurement filter – 3dB point,Δf	Frequency offset of measurement filter centre frequency, f_offset	Maximum level	Measurement bandwidth
2.5 ≤ Δf < 2.7 MHz	2.515MHz ≤ f_offset < 2.715MHz	[P - 53] dBm	30 kHz
2.7 ≤ Δf < 3.5 MHz	2.715MHz ≤ f_offset < 3.515MHz	[P - 53 - 15·(f_offset - 2.715)] dBm	30 kHz
(see note)	3.515MHz ≤ f_offset < 4.0MHz	[P-65] dBm	30 kHz
3.5 ≤ Δf < 7.5 MHz	4.0MHz ≤ f_offset < 8.0MHz	[P - 52] dBm	1 MHz
7.5 ≤ Δf MHz	8.0MHz ≤ f_offset < f_offset_{max}	[P - 56] dBm	1 MHz

Table 6.5: Spectrum emission mask values, maximum output power P < 31 dBm

Frequency offset of measurement filter – 3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Maximum level	Measurement bandwidth
2.5 ≤ Δf < 2.7 MHz	2.515MHz ≤ f_offset < 2.715MHz	[-22] dBm	30 kHz
2.7 ≤ Δf < 3.5 MHz	2.715MHz ≤ f_offset < 3.515MHz	[-22 - 15·(f_offset - 2.715)] dBm	30 kHz
(see note)	3.515MHz ≤ f_offset < 4.0MHz	[-34] dBm	30 kHz
3.5 ≤ Δf < 7.5 MHz	4.0MHz ≤ f_offset < 8.0MHz	[-21] dBm	1 MHz
7.5 ≤ Δf MHz	8.0MHz ≤ f_offset < f_offset_{max}	[-25] dBm	1 MHz

NOTE: This frequency range ensures that the range of values of f_offset is continuous.

6.3.2 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 repeaters RF output port.

Unless otherwise stated, all requirements are measured as mean power.

6.3.2.1 Mandatory Requirements

The requirements of either subclause 6.3.2.1.1 or subclause 6.3.2.1.2 shall apply whatever the type of repeater considered (one or several operating bands). It applies for all configurations foreseen by the manufacturer's specification.

Either requirement applies at frequencies within the specified frequency ranges that are more than 12.5 MHz below the centre frequency of the first 5 MHz channel or more than 12.5 MHz above the centre frequency of the last 5 MHz channel in the operating band.

6.3.2.1.1 Minimum Requirement (Category A)

The following requirements shall be met in cases where Category A limits for spurious emissions, as defined in ITU-R Recommendation SM.329-8 [1], are applied.

At maximum repeater gain, with WCDMA signals in the operating band of the repeater, at levels that produce the maximum rated output power per channel, the power of any spurious emission shall not exceed the limits specified in table 6.6.

When the power in all channels is increased by 10 dB the requirements shall still be met.

NOTE 1: If the operating band corresponds to three or more consecutive nominal 5 MHz channels, the requirement shall be met with WCDMA modulated signals at the frequencies corresponding to the first and the last channel in the operating band.

Table 6.6: Up-link and down-link: Mandatory spurious emissions limits, Category A

Band	Maximum level	Measurement Bandwidth	Note
9kHz – 150kHz	-13 dBm	1 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
150kHz – 30MHz		10 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
30MHz – 1GHz		100 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
1GHz – 12.75 GHz		1 MHz	Upper frequency as in ITU-R SM.329-8, s2.6

6.3.2.1.2 Minimum Requirement (Category B)

The following requirements shall be met in cases where Category B limits for spurious emissions, as defined in ITU-R Recommendation SM.329-8 [1], are applied.

At maximum repeater gain, with WCDMA signals in the operating band of the repeater, at levels that produce the maximum rated power output per channel, the power of any spurious emission shall not exceed the limits specified in tables 6.7 and 6.8 for the down- and up-link, respectively.

When the power in all channels is increased by 10 dB the requirements shall still be met.

NOTE 1: If the operating band corresponds to three or more consecutive nominal 5 MHz channels, the requirement shall be met with WCDMA modulated signals at the frequencies corresponding to the first and the last channel in the operating band.

Table 6.7: Down-link: Mandatory spurious emissions limits, Category B

Band	Maximum Level	Measurement Bandwidth	Note
9kHz ↔ 150kHz	-36 dBm	1 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
150kHz ↔ 30MHz	- 36 dBm	10 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
30MHz ↔ 1GHz	-36 dBm	100 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
1GHz ↔ Fc1 - 60 MHz or 2100 MHz *whichever is the higher*	-30 dBm	1 MHz	Bandwidth as in ITU-R SM.329-8, s4.1
Fc1 – 60 MHz or 2100 MHz *whichever is the higher* ↔ Fc1 – 50 MHz or 2100 MHz *whichever is the higher*	-25 dBm	1 MHz	Specification in accordance with ITU-R SM.329-8, s4.1
Fc1 – 50 MHz or 2100 MHz *whichever is the higher* ↔ Fc2 + 50 MHz or 2180 MHz *whichever is the lower*	-15 dBm	1 MHz	Specification in accordance with ITU-R SM.329-8, s4.1
Fc2 + 50 MHz or 2180 MHz *whichever is the lower* ↔ Fc2 + 60 MHz or 2180 MHz *whichever is the lower*	-25 dBm	1 MHz	Specification in accordance with ITU-R SM.329-8, s4.1
Fc2 + 60 MHz or 2180 MHz *whichever is the lower* ↔ 12.75 GHz	-30 dBm	1 MHz	Bandwidth as in ITU-R SM.329-8, s4.1. Upper frequency as in ITU-R SM.329-8, s2.6

Table 6.8: Up-link: Mandatory spurious emissions limits, Category B

Band	Maximum Level	Measurement Bandwidth	Note
9kHz ↔ 150kHz	-36 dBm	1 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
150kHz ↔ 30MHz	- 36 dBm	10 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
30MHz ↔ 1GHz	-36 dBm	100 kHz	Bandwidth as in ITU-R SM.329-8, s4.1
1GHz ↔ Fc1 - 60 MHz or 1910 MHz *whichever is the higher*	-30 dBm	1 MHz	Bandwidth as in ITU-R SM.329-8, s4.1
Fc1 – 60 MHz or 1910 MHz *whichever is the higher* ↔ Fc1 – 50 MHz or 1910 MHz *whichever is the higher*	-25 dBm	1 MHz	Specification in accordance with ITU-R SM.329-8, s4.1
Fc1 – 50 MHz or 1910 MHz *whichever is the higher* ↔ Fc2 + 50 MHz or 1990 MHz *whichever is the lower*	-15 dBm	1 MHz	Specification in accordance with ITU-R SM.329-8, s4.1
Fc2 + 50 MHz or 1990 MHz *whichever is the lower* ↔ Fc2 + 60 MHz or 1990 MHz *whichever is the lower*	-25 dBm	1 MHz	Specification in accordance with ITU-R SM.329-8, s4.1
Fc2 + 60 MHz or 1990 MHz *whichever is the lower* ↔ 12.75 GHz	-30 dBm	1 MHz	Bandwidth as in ITU-R SM.329-8, s4.1. Upper frequency as in ITU-R SM.329-8, s2.6

Fc1: Centre frequency of emission of the first 5 MHz channel in an operating band.

Fc2: Centre frequency of emission of the last 5 MHz channel in an operating band.

6.4 Modulation accuracy

6.4.1 Error Vector Magnitude

The modulation accuracy is defined by the Error Vector Magnitude (EVM), which is a measure of the difference between the theoretical waveform and a modified version of the measured waveform. This difference is called the error vector. The measured waveform is modified by first passing it through a matched root raised cosine filter with bandwidth 3.84 MHz and roll-off α=0.22. The waveform is then further modified by selecting the frequency, absolute phase, absolute amplitude and chip clock timing so as to minimise the error vector. The EVM result is defined as root of the ratio of the mean error vector power to the mean reference signal power expressed as a %.

The measurement interval is one power control group (timeslot). The repeater shall operate with an ideal WCDMA signal in the operating band of the repeater at a level, which produce the maximum rated output power per channel, as specified by the manufacturer.

6.4.1.1 Minimum requirement

The Error Vector Magnitude shall not be worse than [TBD] %.

6.4.2 Peak code domain error

The peak code domain error is computed by projecting the power of the error vector (as defined in subclause 6.5.1) onto the code domain at a specified spreading factor. The code domain error for every code in the domain is defined as the ratio of the mean power of the projection onto that code, to the mean power of the composite reference waveform. This ratio is expressed in dB. The peak code domain error is defined as the maximum value for the code domain error for all codes. The measurement interval is one power control group (timeslot).

6.4.2.1 Minimum requirement

The peak code domain error shall not exceed [TBD] dB at spreading factor 256.

7 Receiver characteristics

7.1 Blocking characteristics

This section only applies to UTRA/FDD repeaters.

Blocking characteristics is a measure of the capability of the repeater to inhibit the generation of interference in the operating band, in the presence of interfering signal(s) on frequencies other than the operating band.

7.1.1 Minimum requirement

For the parameters specified in table 7.1 and 7.2, the power of any spurious signal in the operating band, with the repeater operating at maximum gain, shall not exceed [TBD] dBm at the output of the repeater.

Table 7.1 specifies the parameters for one interfering signal and the following notation apply:

- f_offset_min is the minimum separation between the centre frequency of first or last 5 MHz channel in the operating band and the interfering signal.

Table 7.1 : Blocking characteristics requirement -One interfering signal

Frequency of Interfering Signal	Interfering Signal Level	f_offset_min	Type of Interfering Signal	Applies to
1900 – 2000 MHz	[TBD] dBm	[TBD] MHz	CW carrier	Up-link direction
2090 – 2190 MHz	[TBD] dBm	[TBD] MHz	CW carrier	Down-link direction

Table 7.2 specifies the parameters for two interfering signals and the following notation applies:

- f_offset is the separation between the centre frequency of first or last 5 MHz channel in the operating band and one the interfering signals.
- Δf is the distance between the two interfering signals.
- Δf_{max} is the nominal bandwidth of the operating band.

Table 7.2 : Blocking characteristics requirement -Two interfering signals

f_offset	Interfering Signal Levels	Offset between the interfering signals (Δf)	Type of signals
[TBD] MHz	[TBD] dBm	200 kHz to Δf_{max} with a 200 kHz step-size	2 CW carriers

History

Document history		
V0.0.1	2000-05-25	Document R4-000356 with a suggestion to V0.0.1 of this current specification approved at RAN WG4 #12
V1.0.0	2000-09-13	Inclusion of the text proposals approved by RAN WG4 #13 and submitted to RAN #9 for information.

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