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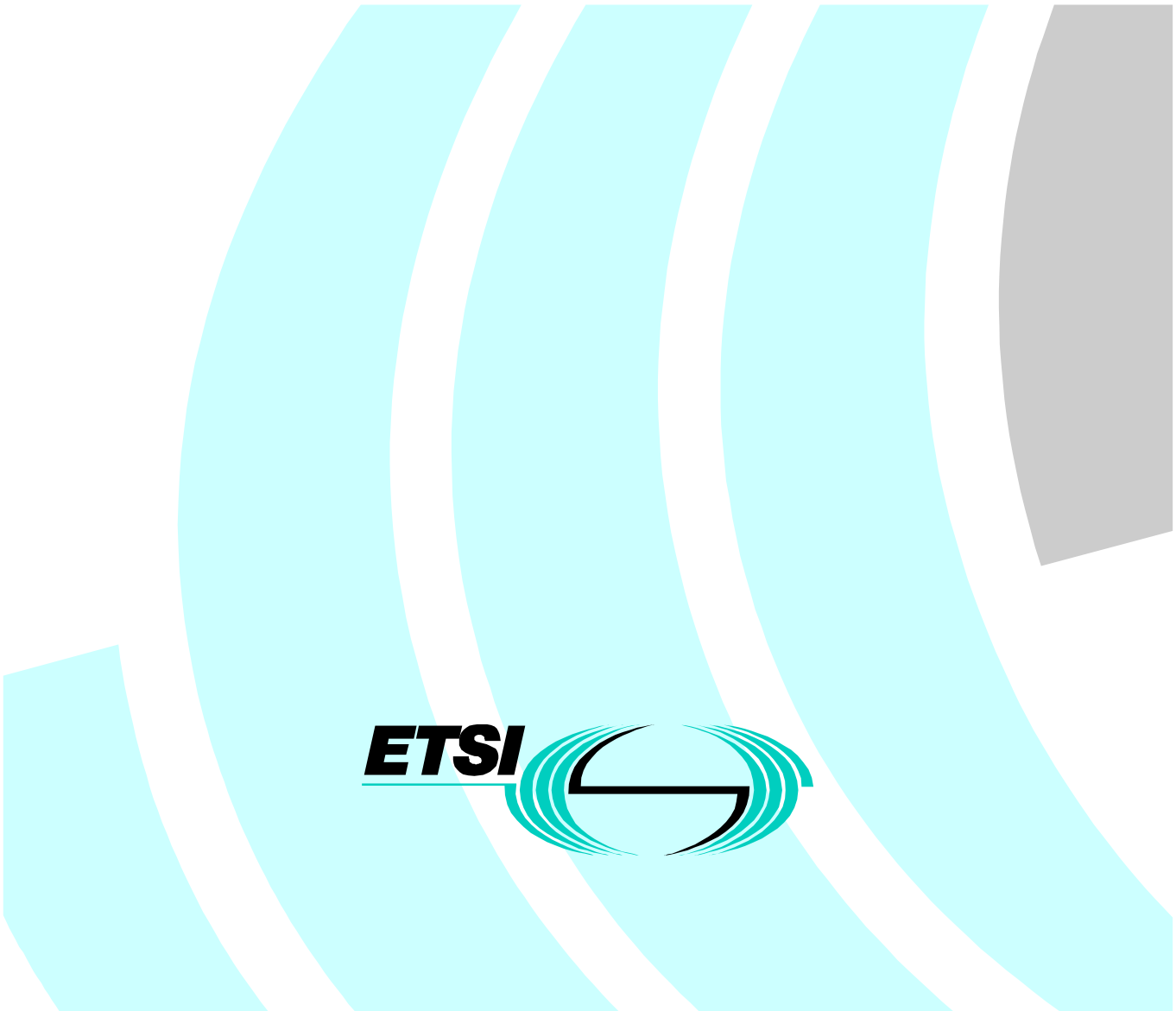
European Standard (Telecommunications series)

Fixed Radio Systems;
Point-to-multipoint equipment;
Part 5: Point-to-multipoint digital radio systems below 1 GHz - Additional parameters for DS-CDMA systems



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Contents

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM).

The present document is part 5 of a multi-part deliverable covering the Fixed Radio Systems; Point-to-multipoint equipment, as identified below:

Part 1: "Point-to-multipoint digital radio systems below 1 GHz - Common parameters";

Part 2: "Point-to-multipoint digital radio systems below 1 GHz - Additional parameters for TDMA systems";

Part 3: "Point-to-multipoint digital radio systems below 1 GHz - Additional parameters for FH-CDMA systems";

Part 4: "Point-to-multipoint digital radio systems below 1 GHz - Additional parameters for FDMA systems";

Part 5: "Point-to-multipoint digital radio systems below 1 GHz - Additional parameters for DS-CDMA systems".

National transposition dates	
Date of adoption of this EN:	13 October 2000
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1 Scope

The present document specifies the access-unique minimum requirements for Direct Sequence Code Division Multiple Access (DS-CDMA) point to multipoint fixed digital radio systems (DRRS) below 1 GHz.

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.
- 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] ETSI EN 301 460-1: "Fixed Radio Systems; Point-to-multipoint equipment; Part 1: Point-to-multipoint digital radio systems below 1 GHz - Common parameters".

[2] ETSI EN 301 055: "Fixed Radio Systems; Point-to-multipoint equipment; Direct Sequence Code Division Multiple Access (DS-CDMA); Point-to-multipoint digital radio systems in frequency bands in the range 1 GHz to 3 GHz".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

chip: unit of modulation used in Direct Sequence Code Division Multiple Access (DS-CDMA)

chip rate: number of chips per second, e.g. Mchip/s

chip sequence: sequence of chips with defined length and chip polarities

DSSS modulation: form of modulation whereby a combination of data to be transmitted and a fixed code sequence (chip sequence) is used to directly modulate a carrier, e.g. by phase shift keying

single DS-CDMA signal: single traffic channel and any associated signalling and synchronization overhead

system loading: number of simultaneous traffic channels at 64 kbit/s in a given radio channel

maximum system loading: number of simultaneous 64 kbit/s traffic channels in a given radio channel for the class of operation declared by the manufacturer

round trip delay: sum of the delays between points F to G and G to F in figure 1, part 1, Baseband interface reference points F/G, including any repeaters if appropriate

3.2 Symbols

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

dB	decibel
dBm	decibels relative to one milliwatt
kbit/s	kilobits per second

3.3 Abbreviations

For the purposes of the present document, the following terms and abbreviations apply.

ATPC	Automatic Transmit Power Control
BER	Bit Error Rate
BW	Bandwidth
CS	Central Station
CW	Continuous Wave
DS-CDMA	Direct Sequence Code Division Multiple Access
DSSS	Direct Sequence Spread Spectrum
ISDN	Integrated Services Digital Network
MSL	Maximum System Loading
RF	Radio Frequency
RS	Repeater Station
RSL	Received Signal Level
RTPC	Remote Transmit Power Control
TE	Terminal Equipment
TMN	Telecommunications Management Network
TS	Terminal Station
Tx	Transmitter

4 General characteristics

4.1 General system architecture

Refer to EN 301 460-1 [1].

4.2 Frequency bands and channel arrangements

4.2.1 Channel plan

In DS-CDMA systems the required channel spacing is determined by the chip rate. For the purposes of the present document, the following example channel spacings have been defined (see table 1).

Table 1: Channel spacing

Channel spacing (MHz)	5,0	10,0	15,0

Other channel spacing may also be employed. Corresponding parameters for 3,5 MHz, 7 MHz and 14 MHz channel spacing may be found in EN 301 055 [2]. Further channel spacings are available by scaling proportionally all channel-related parameters in the present document.

4.2.2 Duplex methods

Refer to EN 301 460-1 [1].

4.3 Compatibility requirements

Refer to EN 301 460-1 [1].

4.4 Transmission error performance

Refer to EN 301 460-1 [1].

4.5 Environmental conditions

Refer to EN 301 460-1 [1].

4.6 Power supply

Refer to EN 301 460-1 [1].

4.7 Electromagnetic compatibility

Refer to EN 301 460-1 [1].

4.8 TMN interfaces

Refer to EN 301 460-1 [1].

4.9 Synchronization of interface bit rates

Refer to EN 301 460-1 [1].

4.10 Branching / feeder / antenna requirements

Refer to EN 301 460-1 [1].

5 System parameters

5.1 System capacity

The system capacity parameter considered in the present document is the transmission capacity of the CS, which is the maximal payload bit rate transmitted over the air between a given CS and its associated remote stations (TSs and RSs). The system is intended for rural applications and as such is assumed to service telephone densities below 1 telephone per km^2.

Due to particular features of DS-CDMA, the system capacity is a free design parameter. However in order to define the performance of the system in the present document a maximum system loading shall be used. The manufacturer shall declare which class the equipment meets. The class will define the number of 64 kbit/s traffic channels that can co-exist within a single allocated radio channel with a Bit Error Rate (BER) lower than or equal to 10^{-6}. Different classes of equipment against maximum system loading have been given in table 3 through table 8.

Systems may use orthogonal (class A) or pseudo random (class B) code sequences. For both, the BER for a single traffic channel will degrade as the number of simultaneous traffic channels increases. Class A systems degrade only slightly because of implementation errors; class B systems degrade more quickly because all traffic channels interfere with each other as noise. Thus the capacity of a class B system will be significantly less than that of a class A system in a single cell environment but may, when deployed in a reuse environment, provide similar network capacity.

5.1.1 Maximum System Loading (MSL)

Manufacturers shall declare the MSL for a system. The system performance shall equal or exceed that given in table 3 through table 8 at the declared MSL.

The minimum number of simultaneous traffic channels for class A and class B systems is given in table 2. For channel spacings 3,5 MHz, 7 MHz and 14 MHz, see EN 301 055 [2].

Table 2: Minimum number of simultaneous 64 kbits/s traffic channels

Channel Spacing →	5 MHz	10 MHz	20 MHz
Class of operation ↓	Minimum number of simultaneous 64 kbit/s traffic channels	Minimum number of simultaneous 64 kbit/s traffic channels	Minimum number of simultaneous 64 kbit/s traffic channels
A	20	40	60
B	11	22	33

Class A systems shall exceed the BER performance in table 3, table 4 and table 5 for the relevant radio channel spacing.

Class B systems shall exceed the BER performance in table 6, table 7 and table 8 for the relevant radio channel spacing.

NOTE 1: The nomenclature used for class of operation in table 3 through table 8 is derived from the declared number of 64 kbit/s users that can be supported under maximum loading conditions and on whether the system uses orthogonal (class A) operation or non orthogonal (class B) operation.

NOTE 2: Table 3 through table 8 extend below the minimum allowed class of operation for information about performance under light loading conditions.

NOTE 3: For systems that do not support exact multiples of 64 kbit/s traffic, the system must support at least the equivalent total traffic in bit/s e.g. a class A20 system must support at least 1,28 Mbit/s total traffic. When performing tests to verify the performance against table 3 through table 14 the total traffic carried by the system must not be less than the equivalent to the appropriate number of 64 kbit/s channels or users, e.g. an A20 system may be considered to be operating at its declared loading when carrying 9 x 144 kbit/s ISDN calls.

NOTE 4: The RSL in table 3 through table 8 are the power per 64 kbit/s user and do not include any contribution due to the necessary signalling and synchronization overhead.

NOTE 5: For channel spacings 3,5 MHz, 7 MHz and 14 MHz, see EN 301 055 [2].

Table 3: MSL-class A 5 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user) at BER	
		10^{-3}	10^{-6}
	2	-103	-101
	4	-103	-101
	6	-103	-101
	8	-102	-100
	10	-102	-100
	12	-102	-100
	14	-101	-99
	16	-101	-99
	18	-101	-99
A20	20	-100	-98
A22	22	-100	-98
A24	24	-99	-97
A26	26	-98	-96
A28	28	-98	-96
A30	30	-97	-95

Table 4: MSL - class A 10 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user) at BER	
		10^{-3}	10^{-6}
	4	-103	-101
	8	-103	-101
	12	-103	-101
	16	-102	-100
	20	-102	-100
	24	-102	-100
	28	-101	-99
	32	-101	-99
	36	-101	-99
A40	40	-100	-98
A44	44	-100	-98
A48	48	-99	-97
A52	52	-98	-96
A56	56	-98	-96
A60	60	-97	-95

Table 5: MSL - class A 15 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user) at BER	
		10^{-3}	10^{-6}
	6	-103	-101
	12	-103	-101
	18	-103	-101
	24	-102	-100
	30	-102	-100
	36	-102	-100
	42	-101	-99
	48	-101	-99
	54	-101	-99
A60	60	-100	-98
A66	66	-100	-98
A72	72	-99	-97
A78	78	-99	-96
A84	84	-98	-96
A90	90	-97	-95

Table 6: MSL - class B 5,0 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user) at BER	
		10^{-3}	10^{-6}
	1	-103	-101
	2	-103	-101
	3	-103	-101
	4	-102	-100
	5	-102	-100
	6	-101	-99
	7	-101	-99
	8	-100	-98
	9	-100	-98
	10	-99	-97
B11	11	-99	-97
B12	12	-98	-96
B13	13	-98	-96
B14	14	-97	-95
B15	15	-97	-95

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user) at BER	
B16	16	-96	-94
B17	17	-96	-94
B18	18	-96	-94
B19	19	-95	-93
B20	20	-95	-93
B21	21	-94	-92
B22	22	-94	-92
B23	23	-93	-91
B24	24	-93	-91
B25	25	-92	-90
B26	26	-92	-90
B27	27	-91	-89
B28	28	-91	-89
B29	29	-90	-88
B30	30	-90	-88

Table 7: MSL - class B 10 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user) at BER	
		10^{-3}	10^{-6}
	2	-103	-101
	4	-103	-101
	6	-102	-100
	8	-102	-100
	10	-101	-99
	12	-101	-99
	14	-100	-98
	16	-100	-98
	18	-100	-98
	20	-99	-97
B22	22	-99	-97
B24	24	-98	-96
B26	26	-98	-96
B28	28	-97	-95
B30	30	-97	-95
B32	32	-96	-94
B34	34	-96	-94
B36	36	-95	-93
B38	38	-95	-93
B40	40	-94	-92
B42	42	-94	-92
B44	44	-93	-91
B46	46	-93	-91
B48	48	-93	-91
B50	50	-92	-90
B52	52	-92	-90
B54	54	-91	-89
B56	56	-91	-89
B58	58	-90	-88
B60	60	-90	-88

Table 8: MSL - class B 15 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm per 64 kbit/s user) at BER	
		10^{-3}	10^{-6}
	3	-103	-101
	6	-103	-101
	9	-102	-100
	12	-102	-100
	15	-101	-99
	18	-101	-99
	21	-100	-98
	24	-100	-98
	27	-100	-98
	30	-99	-97
B33	33	-99	-97
B36	36	-98	-96
B39	39	-98	-96
B42	42	-97	-95
B45	45	-97	-95
B48	48	-96	-94
B51	51	-96	-94
B54	54	-95	-93
B57	57	-95	-93
B60	60	-94	-92

5.2 Round trip delay

Refer to EN 301 460-1 [1].

5.3 Transparency

Refer to EN 301 460-1 [1].

5.4 Voice coding methods

Refer to EN 301 460-1 [1].

5.5 Transmitter characteristics

5.5.1 Transmitter output power

Transmit output power shall comply with EN 301 460-1 [1].

5.5.2 Automatic Transmit Power Control (ATPC)

Equipment with ATPC will be subject to manufacturer declaration of the ATPC range and related tolerances. Testing shall be carried out with output level corresponding to:

- ATPC set manually to a fixed value for system performance;
- ATPC set at maximum provided output power for Tx performance.

5.5.2.1 Remote Transmit Power Control (RTPC)

Equipment with RTPC will be subject to manufacturer declaration of the RTPC range and related tolerances. Testing shall be carried out with output level corresponding to:

- RTPC set manually to the maximum and to the minimum values for system performance;
- RTPC set at maximum provided output power for Tx performance.

RF spectrum mask will be verified at three points (lower, medium and upper part of the frequency band envisaged), if applicable.

5.5.3 Tx Local Oscillator (LO) frequency arrangements

Refer to EN 301 460-1 [1].

5.5.4 RF spectrum mask

The spectrum mask is given in Figure 1. No allowance is made for frequency tolerance.

The transmitted output power spectrum is defined as the spectrum when modulated with a test data signal that simulates a system operating under maximum system loading conditions.

The spectrum measurement shall be performed at point C' of the RF system block diagram Figure 2 of EN 301 406-1 [1]. It shall be performed with the maximum hold function and settings in table 9 on the spectrum analyser selected.

The reference level of the output spectrum means that the 0 dB level is the top of the modulated spectrum, disregarding residual carrier.

Table 9: Spectrum analyser settings

Resolution BW	Video BW	Sweep time
30 kHz	300 Hz	10 s

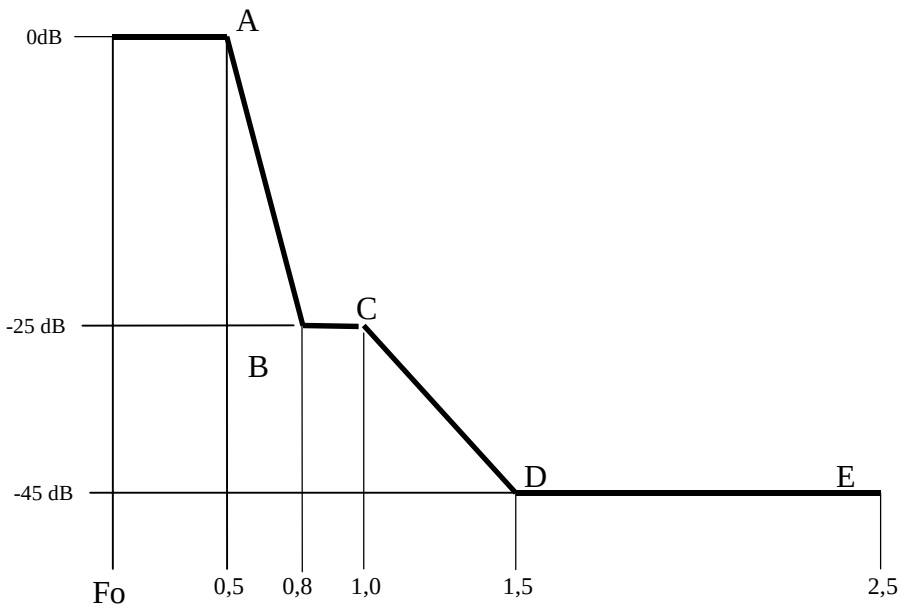

Figure 1: DS-CDMA spectrum mask normalized for channel spacing

Table 10: Channel spacing against spectrum mask reference points

Relative level→	Point A 0 dB	Point B -25 dB	Point C -25 dB	Point D -45 dB	Point E -45 dB
Channel spacing (MHz)↓	0,5 x channel spacing	0,8 x channel spacing	1,0 x channel spacing	1,5 x channel spacing	2,5 x channel spacing
5	2,5 MHz	4 MHz	5 MHz	7,5 MHz	12,5 MHz
10	5 MHz	8 MHz	10 MHz	15 MHz	25 MHz
15	7,5 MHz	12 MHz	15 MHz	22,5 MHz	37,5 MHz

NOTE: For channel spacings 3,5 MHz, 7 MHz and 14 MHz, see EN 301 055 [2].

5.5.5 Radio frequency tolerance

Refer to EN 301 460-1 [1].

5.5.6 Spurious emissions

The equipment shall comply with the spurious emissions requirements of EN 301 460-1 [1].

5.6 Receiver characteristics

5.6.1 Input level range

Table 11 defines, for the appropriate receiver type and a single DS-CDMA signal, the dynamic range above the receiver threshold level defined in table 12, for which the BER shall be 10^{-3} or less.

NOTE: The input level range for receivers facing terminal stations is lower because of the use of ATPC.

Table 11: Input level range

Terminal station	60 dB
Repeater station (facing central station)	60 dB
Repeater station (facing terminal station)	20 dB
Central station	20 dB

5.7 System performance

5.7.1 Dynamic level range

For repeater stations (facing terminal stations) and central stations the overall dynamic level range shall be equal to or greater than 60 dB.

5.7.2 BER as a function of RSL

For a single CDMA signal receiver BER thresholds (dBm) referred to point C of the RF block diagram (see figure 2 of part 1) for a BER of 10^{-3} and 10^{-6} shall be equal to or lower than those stated in table 12. These values do not include any contribution due to the necessary signalling and synchronization overhead.

Table 12: BER performance thresholds

User Bit Rate	RSL for BER 10^{-3}	RSL for BER 10^{-6}
(kbit/s)	(dBm)	(dBm)
64	-103	-101

5.7.3 Interference sensitivity (external)

5.7.3.1 Co-channel interference

All receive signal levels and interference level measurements are referred to point C of the system block diagram, given in figure 2 of part 1.

The limits of co-channel interference for uncorrelated, like-modulated signals shall be as in table 13.

For a declared loading of N signals applied to the receiver each at a level greater by 1 or 3 dB than the relevant level specified in table 12 an applied additional co-channel interferer with un-correlated, like modulation in the same bandwidth at the relevant level specified in table 13 shall not cause the BER to exceed the relevant specified figure. For channel spacings 3,5 MHz, 7 MHz and 14 MHz, see EN 301 055 [2].

Table 13: Co-channel sensitivity

	BER 10^{-6}	
Threshold degradation→	**1 dB**	**3 dB**
Channel spacing MHz ↓	**Interference level (dBm)**	**Interference level (dBm)**
5	-110	-104
10	-107	-101
15	-105	-99

5.7.3.2 Adjacent channel interference

All receive signal levels and interference level measurements are referred to point C of the system block diagram, given in figure 2 of part 1.

The limits of adjacent channel interference for an uncorrelated, like-modulated signal shall be as in table 14. For a declared loading of N signals applied to the receiver, each at a level greater by 1 or 3 dB than the relevant level specified in table 12 an applied additional adjacent channel interferer with un-correlated like-modulation in the same bandwidth at the relevant signal level specified in table 14 shall not cause the BER to exceed the relevant specified value. For channel spacings 3,5 MHz, 7 MHz and 14 MHz, see EN 301 055 [2].

Table 14: Adjacent channel sensitivity

	BER 10^{-6}	
Threshold degradation→	**1 dB**	**3 dB**
Channel spacing MHz ↓	**Interference level (dBm)**	**Interference level (dBm)**
5	-94	-88
10	-91	-85
15	-89	-83

5.7.4 Distortion sensitivity

Refer to EN 301 460-1 [1].

5.7.5 CW interference

For a receiver operating at the RSL specified in subclause 5.4.4.1 for 10^{-6} BER threshold, the introduction of a CW interferer at a level of +30 dB with respect to the wanted signal and at any frequency up to 26 GHz, excluding frequencies either side of the wanted frequency up to 450 % of the channel spacing, shall not result in a BER greater than 10^{-5}. This is considered equivalent to a 1 dB degradation of the 10^{-6} BER threshold.

5.7.6 Two tone interference

Refer to EN 301 460-1 [1].

5.7.7 Impulsive interference

Refer to EN 301 460-1 [1].

6 Types of interfaces at the subscriber equipment and the network exchange

Refer to EN 301 460-1 [1].

History

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