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European Standard (Telecommunications series)

Fixed Radio Systems;
Point-to-multipoint equipement;
Direct Sequence Code Division Multiple Access (DS-CDMA) point-to-multipoint digital radio systems in frequency bands in the range 3 GHz to 11 GHz

Reference

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Keywords

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Foreword

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

The former title of the present document was: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Direct Sequence Code Division Multiple Access (DS-CDMA) point-to-multipoint DRRS in frequency bands in the range 3 GHz to 11 GHz".

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Introduction

The main field of application of Point-to-Multipoint (P-MP) Systems is to provide access to both public and private networks (PSTN, PDN, …). By means of P-MP systems the network service area may be extended to cover both distant and scattered subscriber locations; and the systems may be applied to build new access networks covering both urban and rural areas.

Subscribers are offered the full range of services by the particular public or private network. Subscribers have access to these services by means of the various standardized user network interfaces (2-wire loop, new data services and ISDN).

P-MP systems provide standard network interfaces and transparently connect subscribers to the appropriate network node. These systems allow a service to be connected to a number of subscribers ranging from a few users to several thousand, and over a wide range of distances.

P-MP systems are generally configured as Pre-Assigned Multiple Access (PAMA) Systems or as Demand-Assigned Multiple Access (DAMA) radio systems.

The essential features of a typical P-MP DAMA radio systems are:

- efficient use of the radio spectrum;
- concentration;
- and transparency.

Radio is often the ideal way of obtaining communications at low cost, almost independent of distance and difficult topography. Moreover, a small number of sites is required for these installations, thus facilitating rapid implementation and minimizing maintenance requirements of the systems.

Concentration means that m subscribers can share n radio channels (m being larger than n), allowing a better use to be made of the available frequency spectrum and at a lower equipment cost. The term "multiple-access" means that every subscriber has access to every channel (instead of a fixed assignment as in most multiplex systems). When a call is initiated an available channel is allocated to it. When the call is terminated, the channel is released for another call.

Concentration requires the use of distributed intelligent control which in turn allows many other operation and maintenance functions to be added.

Transparency means that the exchange and the subscriber equipment communicate with each other without being aware of the radio link.

1 Scope

1.1 Applications

The present document covers the following typical point-to-multipoint applications:

- voice;
- fax;
- voiceband data;
- telex;
- data up to 2 Mbit/s;
- ISDN.

1.2 Frequencies

The present document covers fixed service allocations in the 3 GHz to 11 GHz band. Bands identified by CEPT for P-MP applications between 3 GHz and 11 GHz are:

- 3 410 MHz to 3 600 MHz see ERC Recommendation T/R 14-03 [20];
- 3 600 MHz to 3 800 MHz see ERC Recommendation T/R 12-08 [21]; and
- 10,15 GHz to 10,3 GHz paired with 10,5 to 10,65 GHz see ERC Recommendation T/R 12-05 [22].

1.3 Access method

The present document covers Direct Sequence Code Division Multiple Access (DS-CDMA) systems.

1.4 Compatibility

There is no requirement to operate Central Station (CS) equipment from one manufacturer with Terminal Station (TS) or Repeater Station (RS) equipment from another manufacturer.

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.

[1] ETSI ETS 300 012: "Integrated Services Digital Network (ISDN); Basic user-network interface; Layer 1 specification and test principles".

[2] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".

[3] ITU-T Recommendation Q.553: "Transmission characteristics at 4-wire analogue interfaces of digital exchanges".

[4] ITU-T Recommendation Q.552: "Transmission characteristics at 2-wire analogue interfaces of digital exchanges".

[5] ITU-T Recommendation G.821: "Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network".

[6] ITU-T Recommendation R.20 "Telegraph modem for subscriber lines"; and
ITU-T Recommendation V-series: "Data communication over the telephone network"

[7] ETSI ETS 300 019 (all parts): "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

[8] ITU-T Recommendation G.773: "Protocol suites for Q-interfaces for management of transmission systems".

[9] ETSI EN 300 385: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment".

[10] ITU-T Recommendation G.711: "Pulse code modulation (PCM) of voice frequencies".

[11] ITU-T Recommendation G.726: "40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)".

[12] ITU-T Recommendation G.728: "Coding of speech at 16 kbit/s using low-delay code excited linear prediction".

[13] ITU-T Recommendation G.729: "C source code and test vectors for implementation verification of the G.729 8 kbit/s CS-ACELP speech coder".

[14] ITU-R Recommendation F.697: "Error performance and availability objectives for the local-grade portion at each end of an ISDN connection at a bit rate below the primary rate utilizing digital radio-relay systems".

[15] Void: "Empty".

[16] ITU-T Recommendation G.131: "Control of talker echo".

[17] ETSI ETS 300 132 (all parts): "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment".

[18] ITU-T Radio Regulation 831: "ITU Radio Regulations Part 1".

[19] ETSI EN 300 339: "Electromagnetic compatibility and Radio spectrum Matters (ERM); General ElectroMagnetic Compatibility (EMC) for radio communications equipment".

[20] ERC Recommendation T/R 14-03: "Harmonized radio frequency channel arrangements for low and medium capacity systems in the band 3400 MHz to 3600 MHz".

[21] ERC Recommendation T/R 12-08: "Harmonized radio frequency channel arrangements and block allocations for low, medium and high capacity systems in the band 3600 MHz to 4200 MHz".

[22] ERC Recommendation T/R 12-05: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 10.0 - 10.68 GHz".

[23] ETSI ETS 300 324 (all parts): "V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN)".

[24] ETSI ETS 300 347: "V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN)".

[25] ETSI EN 301 055: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Direct Sequence Code Division Multiple Access (DS-CDMA); Point-to-multipoint DRRS in frequency bands in the range 1 GHz to 3 GHz".

[26] CEPT/ERC Recommendation 74-01: "Spurious Emissions".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

chip: A unit of modulation used in Direct Sequence Spread Spectrum (DSSS) modulation.

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

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

DSSS modulation: A 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: A single traffic channel and any associated signalling and synchronization overhead.

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

maximum system loading: The 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: The sum of the delays between points F to G and G to F in figure 1, 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

3.3 Abbreviations

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

ADPCM	Adaptive Differential Pulse Code Modulation
ATPC	Automatic Transmit Power Control
BER	Bit Error Ratio
BW	BandWidth
CCS	Central Controller Station
CRS	Central Radio Station
CS	Central Station
CS-ACELP	Conjugate Structure Algebraic-Code-Excited Linear-Prediction
CSmin	minimum practical Channel Separation (for a given radio-frequency channel arrangement)
CW	Continuous Wave
DAMA	Demand-Assigned Multiple Access
DS-CDMA	Direct Sequence Code Division Multiple Access
DSSS	Direct Sequence Spread Spectrum
EMC	ElectroMagnetic Compatibility
ISDN	Integrated Services Digital Network
MOS	Mean Opinion Score
MSL	Maximum System Loading

PAMA	Pre-Assigned Multiple Access
PCM	Pulse Code Modulation
PDN	Public Data Network
P-MP	Point-to-MultiPoint
PRBS	Pseudo Random Binary Sequence
PSTN	Public Switched Telephone Network
QDU	Quantization Distortion Unit
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 system architecture

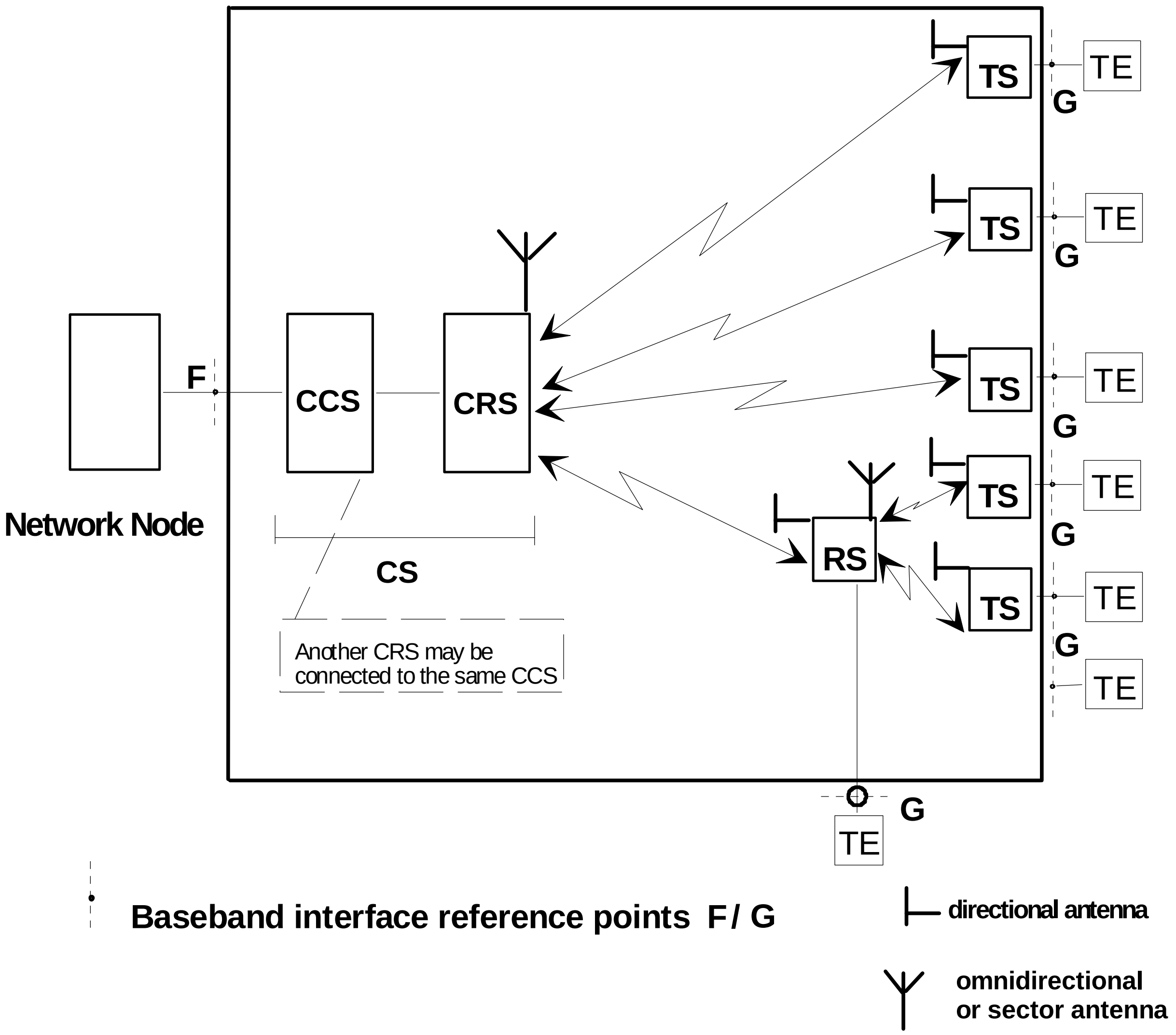


Figure 1: General System Architecture

4.1 Sub-system types

Central Station (CS) which may be subdivided into two units:

CCS: Central Controller Station, which provides the interface to the network node.

CRS: Central Radio Station, which is the central base station containing at least the radio transceiver equipment providing the interface to the terminal station via the air. Each transceiver is connected to a separate antenna. This is used e.g. if sectored cells are applied to increase the capacity of each cell.

TS: Terminal station, which provides the interfaces to the subscriber equipment.

RS: Repeater Station, which may also provide the interfaces to the subscriber, if applicable. A RS may serve one or more TSs.

F: point of connection to the network node.

G: point(s) of connection to the subscriber equipment.

TE: Terminal (Subscriber) Equipment.

NOTE 1: Central Controller Station (CCS) may control more than one Central Radio Station (CRS).

NOTE 2: A TS may serve more than one TE.

The CS performs the interconnection with the network node (local exchange) carrying out a concentration function by sharing the total number of available channels in the system. The central station is linked by microwave transmission paths to each TS either directly or via one or more RS.

Whenever an existing digital transmission link is available, the network implementation can be optimized by separating the CCS, installed at the exchange site, and the CRS.

The general characteristics which are typical for point-to-multipoint systems are considered in the present document. These characteristics have been categorized under four headings:

1) system characteristics;

2) radio characteristics;

3) types of subscriber equipment and network exchange interface;

4) power supply and environmental characteristics.

4.2 System characteristics

4.2.1 Transmission error performance

Equipment shall be designed to be able to meet network performance and availability requirements specified by ITU-T Recommendation G.821 [5] following the criteria defined in ITU-R Recommendation F.697 [14] for the local grade portion of the digital connection.

4.2.2 Round trip delay

The round trip delay for a single 64 kbit/s traffic channel shall not exceed 20 ms.

Longer round trip delays may result at other bit rates and when using speech coding at rates lower than 64 kbit/s. In order to guarantee that the round trip delay introduced by the P-MP system in the transmission network does not degrade the quality of telephone communications, compliance with ITU-T Recommendation G.131 [16] shall be ensured.

4.2.3 Transparency

The system should be fully transparent: the exchange and the subscriber equipment (points F and G in figure 1) communicate with each other without being aware of the radio link. The system should be transparent to analogue or digital subscriber equipment and to voiceband data signals. However, advantage may be taken of coding methods at rates lower than 64 kbit/s to conserve radio spectrum, provided that the above transparency is maintained.

At least one of the following standard coding methods could be employed:

- 64 kbit/s ITU-T Recommendation G.711 [10] which will permit full transparency and a direct digital interface to digital switches;
- 32 kbit/s ITU-T Recommendation G.726 [11];
- 16 kbit/s ITU-T Recommendation G.728 [12];
- 8 kbit/s ITU-T Recommendation G.729 [13].

Other voice coding methods may be employed if the quality (measured for example in Quantization Distortion Unit (QDU) or Mean Opinion Score (MOS)) is equivalent to the above. The coding method used shall be declared by the manufacturer.

4.2.4 TMN interface

TMN interface, if any, should be in accordance with ITU-T Recommendation G.773 [8].

4.2.5 Synchronization

Systems employing digital interfaces shall include methods enabling internal and external synchronization to the network.

5 Radio characteristics

5.1 Frequency bands

The present document is intended to be generic and does not contain specific frequency plans. It may be applied to fixed service allocations in the range 3 GHz to 11 GHz. Bands identified by CEPT for P-MP applications between 3 and 11 GHz are:

- 3 410 MHz to 3 600 MHz see ERC Recommendation T/R 14-03 [20];
- 3 600 MHz to 3 800 MHz see ERC Recommendation T/R 12-08 [21]; and
- 10,15 GHz to 10,3 GHz paired with 10,5 GHz to 10,65 GHz see ERC Recommendation T/R 12-05 [22].

National authorities may allocate specific bands for P-MP systems on a national / geographic basis.

5.2 Channel arrangement

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 spacings may also be employed. Corresponding parameters for 3,5 MHz, 7 MHz and 14 MHz channel spacings may be found in EN 301 055 [25]. Further channel spacings are available by scaling proportionally all channel related parameters in the present document.

5.2.1 System loading

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 Ratio (BER) lower than or equal to 10^{-6}. Different classes of equipment against maximum system loading have been given in table 6A.

5.3 Transmitter (Tx) characteristics

5.3.1 Tx power range

Maximum averaged output power shall not exceed 43 dBm (27 dBm in the band 10,6 GHz to 10,65 GHz [18]) at point C' of the RF block diagram (see figure 2). For channel spacings of 10 MHz or greater, in the bands below 10,6 GHz the maximum averaged output power shall not exceed 46 dBm.

An internal or external means of adjustment shall be provided.

The transmitted output power means the value measured where the output is connected to a dummy load, e.g. power meter or spectrum analyser. The transmitter is modulated with a 64 kbit/s PRBS test data signal to simulate traffic.

NOTE: Points B & C and B' & C' will coincide if branching networks are not used.

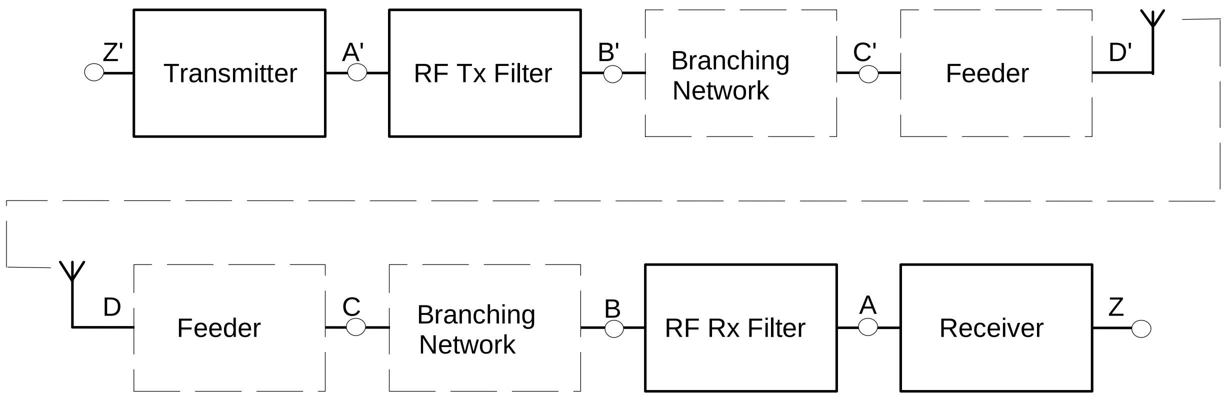


Figure 2: RF system block diagram

5.3.1.1 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.

5.3.1.2 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.

5.3.2 Spectrum mask

5.3.2.1 Spectrum density mask

The spectrum mask is given in figure 3. 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 at point C' of the RF system block diagram figure 2 shall be performed with the maximum hold function 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 2: Spectrum analyser settings

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

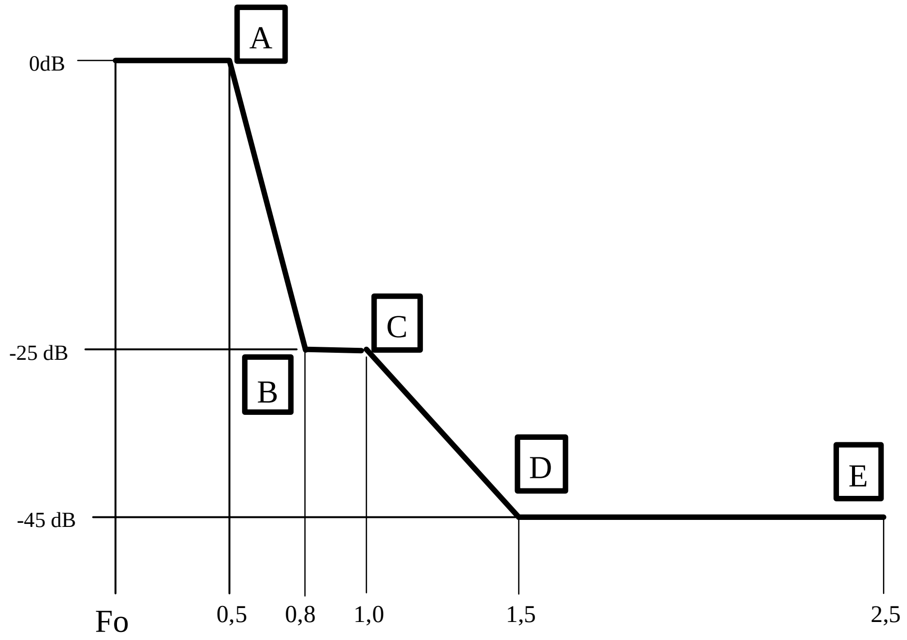


Figure 3: DS-CDMA spectrum mask normalized for channel spacing

Table 3: 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 [25].					

5.3.2.2 Discrete CW components exceeding the spectrum mask limit (all stations)

In case some CW components exceed the spectrum mask, an additional allowance is given.

Those lines shall not:

- exceed the mask by a factor more than {10 log (CSmin/IFbw) -10} dB (Note)
- be spaced each other in frequency by less than CSmin

Where:

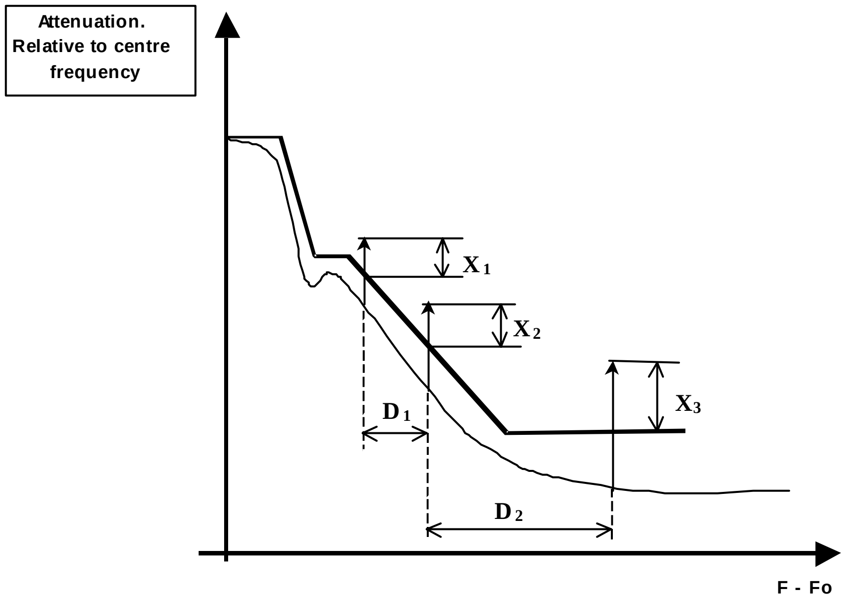
CSmin = 500 kHz for 3,5 and 3,7 GHz bands

CSmin = 1 500 kHz for 10,5 GHz band

IFbw is the recommended resolution bandwidth, expressed in kHz reported in table 2.

NOTE: In case the calculation of the allowance factor will result in a negative value, no additional allowance is then permitted.

Figure 4 shows a typical example of this requirement.



X_1, X_2, X_3 [dB] $\leq$ 10log(CS_{min}/IF_{bw})-10

$D_1, D_2 \geq CS_{min}$

Figure 4: CW lines exceeding the spectrum mask (typical example)

5.3.3 Transmitter spurious emissions

Outside the frequency range ±250 % of the relevant channel spacing, across the nominal centre frequency, CEPT/ERC Recommendation 74-01 [26] shall apply.

5.3.4 Radio Frequency (RF) tolerance

Maximum RF tolerance shall not exceed 20 ppm. This limit includes both short-term factors and long-term ageing effects. For the purpose of type-testing the manufacturer shall state the guaranteed short-term part and the expected ageing part.

5.4 Receiver characteristics

5.4.1 Dynamic range

Table 4 defines, for the appropriate receiver type and a single DS-CDMA signal, the dynamic range above the receiver threshold level defined in table 5, for which the BER shall be 10^{-3} or less.

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

Table 4: Dynamic range

Terminal Station	60 dB
Repeater Station (facing Central Station)	60 dB
Repeater Station (facing Terminal Station)	20 dB
Central Station	20 dB

5.4.2 Broadband Continuous Wave (CW) interference rejection capability

For a receiver operating at the RSL specified in clause 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 1dB degradation of the 10^{-6} BER threshold.

5.4.3 Spurious emissions

CEPT/ERC Recommendation 74-01 [26] shall apply.

5.4.4 BER performance

5.4.4.1 Single signal performance

For a single CDMA signal receiver BER thresholds (dBm) referred to point C of the RF block diagram (see figure 2) for a BER of 10^{-3} and 10^{-6} shall be equal to or lower than those stated in table 5. These values do not include any contribution due to the necessary signalling and synchronization overhead.

Table 5: BER performance thresholds

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

5.4.4.2 Loaded BER performance

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.

5.4.4.3 Maximum System Loading (MSL)

Manufacturers shall declare the MSL for a system. The system performance shall equal or exceed that given in the relevant table 6A at the declared MSL.

The minimum number of simultaneous traffic channels for Class A and Class B systems is given in table 6. For channel spacings 3,5 MHz, 7 MHz and 14 MHz, see EN 301 055 [25].

Table 6: Minimum number of simultaneous 64 kbit/s traffic channels

Channel Spacing →	5 MHz	10 MHz	15 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 tables 6A (a1), (a2) or (a3) for the relevant radio channel spacing.

Class B systems shall exceed the BER performance in tables 6A (b1), (b2) or (b3) for the relevant radio channel spacing.

NOTE 1: The nomenclature used for class of operation in tables 6A (a1) to (b3) 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: Tables 6A (a1) to (b3) 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 tables 6A, 7 and 8 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 9×144 kbit/s ISDN calls.

NOTE 4: The RSL in tables 6A 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 [25].

Table 6A (a1): 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 6A (a2): 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 6A (a3): 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 6A (b1): MSL - Class B 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}
	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
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 6A (b2): 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 6A (b3): 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

5.4.5 Interference sensitivity

5.4.5.1 Co-channel interference sensitivity

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

The limits of co-channel interference for uncorrelated, like-modulated signals shall be as in table 7.

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 6A an applied additional co-channel interferer with un-correlated, like modulation in the same bandwidth at the relevant level specified in table 7 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 [25].

Table 7: 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

5.4.5.2 Adjacent channel interference sensitivity

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

The limits of adjacent channel interference for an uncorrelated, like-modulated signal shall be as in table 8. 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 6A an applied additional adjacent channel interferer with un-correlated like-modulation in the same bandwidth at the relevant signal level specified in table 8 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 [25].

Table 8: 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

5.5 Antenna port characteristics

5.5.1 RF interface

For equipment without an integral antenna, the RF interface at reference points C and C' of the system block diagram, figure 2 shall be either coaxial 50 Ω or an appropriate waveguide flange.

5.5.2 Return loss

For equipment without an integral antenna, the return loss at reference points C and C' of the RF system block diagram (see figure 2) shall be more than 15 dB at the reference impedance.

6 Types of subscriber equipment and network exchange interface

Table 9 lists a range of interfaces for various voice and data services.

The equipment covered by the present document shall use one or more of the standardized interfaces (ITU / ETSI), the more common of which are listed in table 9.

Table 9: Types of interface

Subscriber equipment interfaces	
Analogue (2 wires)	ITU-T Recommendation Q.552 [4]
Analogue (4 W + E & M)	ITU-T Recommendation Q.553 [3]
Telex	ITU-T Recommendation R.20 [6] and V-series [6]
Digital data port	ITU-T Recommendation G.703 [2] , X and V series [2]
ISDN basic rate	ETS 300 012 [1]
Network interfaces	
2 Mbit/s	ITU-T Recommendation G.703 [2]
Analogue (2 wires)	ITU-T Recommendation Q.552 [4]
Analogue (4 W + E & M)	ITU-T Recommendation Q.553 [3]
Telex	ITU-T Recommendation R.20 [6] and V Series [6]
Digital data port	ITU-T Recommendation G.703 [2] , X and V Series [2]
ISDN basic rate	ETS 300 012 [1]
ISDN + Analogue subscribers + Leased lines 2 Mbit/s Interface	V5.1/V5.2 (ETS 300 324 [23] / ETS 300 347 [24]) ITU-T G.703 [2]

NOTE: Further ITU / ETSI interfaces may be implemented. The use of non-standardized interfaces is outside the scope of the present document.

7 Power supply and environmental characteristics

7.1 Power supply

The equipment shall operate from one or more of the power supplies within the ranges specified in tables 10 and 11.

Table 10: Power supplies - DC

Nominal voltage (V)	Voltage range (V)
12	10,8 to 13,6
24	21,8 to 28,1 (ETS 300 132 [17])
48	40,5 to 57,0 (ETS 300 132 [17])
60	50,0 to 72,0

Table 11: Power supplies - AC

For 110 V AC nominal	99 V to 121 V	60 Hz ± 2 Hz
For 230 V AC nominal	207 V to 253 V	50 Hz ± 2 Hz (ETS 300 132 [17])

7.2 Environmental conditions

The equipment shall meet the environmental conditions set out in ETS 300 019 [7] which defines weather-protected and non weather-protected location classes and test severity.

7.2.1 Equipment within weather-protected locations

Equipment intended for operation in temperature-controlled locations or partially temperature-controlled locations shall meet the requirements of ETS 300 019 [7], classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [7], classes 3.3 (non temperature controlled locations), 3.4 (sites with heat trap) and 3.5 (sheltered locations) may be applied.

7.2.2 Equipment for non weather-protected locations

Equipment intended for operation within non-weather protected locations shall meet the requirements of ETS 300 019 [7], class 4.1 or 4.1E .

Class 4.1 applies to many European countries and class 4.1E applies to all European countries.

Weather-protected equipment conforming to class 3.3, 3.4 or 3.5 together with an enclosure or cabinet may fulfil the requirements for operating in a non weather-protected environment but this is outside the scope of the present document.

7.3 ElectroMagnetic Compatibility (EMC) conditions

Equipment with a capacity of 2 Mbit/s and above shall operate under the conditions of EN 300 385 [9]. For lower capacities the subject is under study, however EN 300 339 [19] shall apply on a provisional basis.

Annex A (informative): Bibliography

ITU-R Recommendation SM.329-7: "Spurious emissions".

History

Document history		
V1.1.1	November 1998	Publication
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