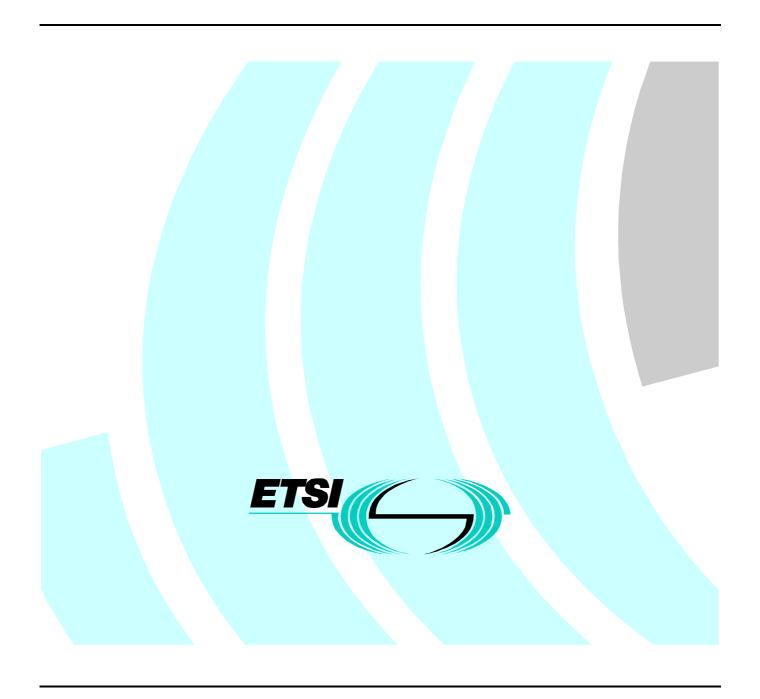# ETSI EN 301 055 V1.4.1 (2001-02)

European Standard (Telecommunications series)

**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**

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Foreword

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

National transposition dates	
Date of adoption of this EN:	16 February 2001
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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, etc.). 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).

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 to several thousand, and over a wide range of distances.

Point-to-Multipoint systems are generally configured as pre-assigned systems or as Demand Assigned Multiple Access (DAMA) radio systems.

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

- efficient use of the radio spectrum;

- concentration;

- transparency.

Radio is often the ideal way of obtaining communications at low cost and 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 better use to be made of the available frequency spectrum and at a lower equipment cost. The term "multi-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 (P-MP) applications:

- voice;

- fax;

- voiceband data;

- telex;

- data up to 64 kbit/s;

- Integrated Services Digital Network (ISDN).

1.2 Frequencies

The present document covers fixed services bands at 1,5 GHz, 2,2 GHz, 2,4 GHz and 2,6 GHz.

The frequency plans for the 1,5 GHz, 2,2 GHz and 2,6 GHz bands are given in CEPT/ERC Report T/R 13-01 [7] and ITU-R Recommendation F.1098-1 [20]. For the 2,4 GHz band, the ITU-R Recommendation F.701-1 [8] is applicable.

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 (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, the latest version applies.

[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".

[7]   CEPT/ERC Report T/R 13-01: "Preferred channel arrangements for fixed services in the range 1-3 GHz".

[8]   ITU-R Recommendation F.701-1: "Radio-frequency channel arrangements for analogue and digital point-to-multipoint radio systems operating in frequency bands in the range 1.350 to 2.690 GHz (1.5, 1.8, 2.0, 2.4 and 2.6 GHz)".

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

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

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

[12]   ETSI EN 300 385 (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment".

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

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

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

[16]   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".

[17]   ITU-R Recommendation F.697-1: "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".

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

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

[20]   ITU-R Recommendation F.1098-1: "Radio-frequency channel arrangements for radio-relay systems in the 1 900 to 2 300 MHz band".

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

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

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 spread spectrum modulation.

chip rate: number of chips per second measured in Mchips/s.

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

direct sequence spread spectrum modulation: form of modulation where 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/synchronization overhead.

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

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

round trip delay: sum of the delays between points A to B and B to A in figure 1 including any repeaters as appropriate.

3.2 Symbols

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

A	interface from local switch to P-MP system
B	interface from P-MP system to customer terminal equipment
GHz	GigaHertz
kbit/s	kilobit per second
Mchip/s	Mega chip per second
MHz	MegaHertz
ppm	parts per million

3.3 Abbreviations

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

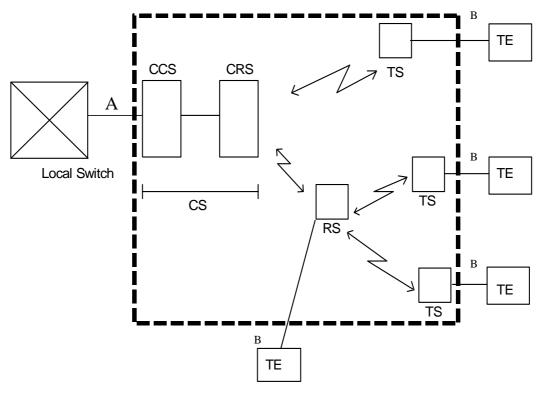|	
BER	Bit Error Rate
BW	BandWidth
CCS	Central Controller Station
CRS	Central Radio Station
CS	Central Station
CSmin	minimum practical Channel Separation (for a given radio-frequency channel arrangement)
DAMA	Demand Assigned Multiple Access
DS-CDMA	Direct Sequence Code Division Multiple Access
MOS	Mean Opinion Score
PDN	Private 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	Receive Signal Level

TE   Terminal Equipment
TMN   Telecommunications Management Network
TS   Terminal Station

4   General system architecture

A system could consist of physical sub-systems as follows (see figure 1):

NOTE: Refer to clause 3.3 for definitions of abbreviations used in this figure.

Figure 1: General system architecture

4.1   Sub-system types

CS: Central Station which can be subdivided into two units:

-   the Central Controller Station (CCS) also called the exchange unit which is the interface to the local switch;

-   the Central Radio Station (CRS) also called the radio unit which is the central baseband / radio transceiver equipment.

TS: Terminal Station (outstations with subscriber interfaces).

RS: Repeater Station (radio repeater outstations with or without subscriber interfaces).

A: Point of connection to local switch.

B: Point(s) of connection for subscriber equipment.

The central station performs the interconnection with the local switching exchange carrying out a concentration function by sharing the total number of available channels in the system. The central station is linked to all remote stations (RS or TS) by microwave transmission paths.

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 P-MP systems are considered in the present document. These characteristics have been categorized under four headings:

1) system characteristics;

2) radio characteristics;

3) type of subscriber and exchange interfaces;

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.697-1 [17] for the local grade portion of the digital connection.

4.2.2 Round trip delay

The round trip delay for a 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 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 [22] shall be ensured.

4.2.3 Transparency

The system shall be transparent: the exchange and the subscriber equipment (points A and B 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: according to ITU-T Recommendation G.711 [13] (which will permit full transparency and a direct digital interface to digital switches);

32 kbit/s: according to ITU-T Recommendation G.726 [14];

16 kbit/s: according to ITU-T Recommendation G.728 [15];

8 kbit/s: according to ITU-T Recommendation G.729 [16].

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, shall be in accordance with ITU-T Recommendation G.773 [11].

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

Five frequency plans are used for digital P-MP systems: two in the 1,5 GHz band, one each in the 2,2 GHz, 2,4 GHz and the 2,6 GHz bands.

5.2 Channel arrangement

Table 1: Frequency bands

Frequency band	Band limits	Recommendation	Transmit/receive spacing
1,5 GHz (I)	1 350 MHz - 1 375 MHz and 1 492 MHz - 1 517 MHz	CEPT/ERC Report T/R 13-01 [7] annex A	142 MHz
1,5 GHz (II)	1 375 MHz - 1 400 MHz and 1 427 MHz - 1 452 MHz	CEPT/ERC Report T/R 13-01 [7] annex B	52 MHz
2,2 GHz	2 025 MHz - 2 110 MHz and 2 200 MHz - 2 290 MHz	CEPT/ERC Report T/R 13-01 [7] annex C	175 MHz
2,4 GHz	2 300 MHz - 2 500 MHz	ITU-R Recommendation F.701-1 [8]	94 MHz
2,6 GHz	2 520 MHz - 2 670 MHz	CEPT/ERC Report T/R 13-01 [7] annex D	74 MHz

Table 2: Channel spacing

Frequency band	Channel spacing (MHz)
1,5 GHz (I)	3,5
1,5 GHz (II)	3,5
2,2 GHz	3,5 7 10,5 14
2,4 GHz	3,5 7 10,5 14
2,6 GHz	3,5 7 10,5 14

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 Ratie (BER) $\leq 10^{-6}$. Different classes of equipment against maximum system loading have been given in table 7.3.

5.3   Transmitter characteristics

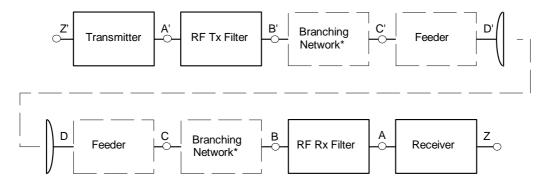## 5.3.1   Transmitter power range

Maximum averaged output power shall not exceed 43 dBm at point C' of the Radio Frequency (RF) system block diagram (see figure 2).

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, i.e. power meter or spectrum analyser. The transmitter is then modulated with a 64 kbit/s Pseudo Random Binary Sequence (PRBS) test data signal to simulate traffic.

Two different measurement methods can be used:

  1) power meter;

  2) spectrum analyser.

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

Figure 2: RF system block diagram

5.3.2   Spectrum masks

5.3.2.1   Spectrum density mask

Spectrum masks are given in figure 3.

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 RF system block diagram (see 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 the residual carrier.

Table 3.1: Spectrum analyser settings

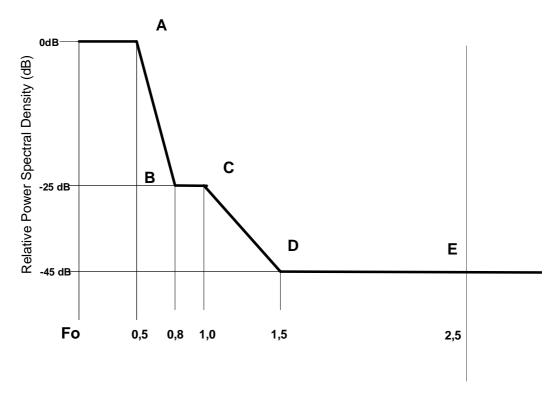| Resolution Bandwidth (BW)	Video BW	Sweep time
30 kHz	300 Hz	10 s

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

Table 3.2: 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 × Channel spacing	0,8 × Channel spacing	1,0 × Channel spacing	1,5 × Channel spacing	2,5 × Channel spacing
3,5	1,75 MHz	2,8 MHz	3,5 MHz	5,25 MHz	8,75 MHz
7	3,5 MHz	5,6 MHz	7,0 MHz	10,5 MHz	17,5 MHz
10,5	5,25 MHz	8,4 MHz	10,5 MHz	15,75 MHz	26,25 MHz
14	7,0 MHz	11,2 MHz	14,0 MHz	21,0 MHz	35,0 MHz

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:

$$CSmin = 25 \text{ kHz for the band } 1,5 \text{ GHz}$$

$$CSmin = 500 \text{ kHz for the band } 2,2 \text{ GHz, } 2,4 \text{ and } 2,6 \text{ GHz}$$

IFbw is the recommended resolution bandwidth, expressed in kHz reported in table 3.1.

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.

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

$$D_1, D_2 \geq CS_{min}$$

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

5.3.3   Transmitter spurious emissions

According to CEPT/ERC Recommendation 74-01 [21] the spurious emissions are defined as emissions at frequencies, which are removed from the nominal carrier frequency more than ±250 % of the relevant channel separation.

Outside the band of ±250 % of the relevant channel separation (CS), the Fixed Service radio systems spurious emission limits, defined by CEPT/ERC Recommendation 74-01 [21] together with the frequency range to consider for conformance measurement, shall apply at reference point C'.

Table 4: Void

5.3.4   RF tolerance

The long-term frequency tolerance shall not be greater than 20 parts per million (ppm).

5.4   Receiver characteristics

5.4.1   Dynamic range

Table 5 defines, for the appropriate receiver type and a single DS-CDMA signal, the dynamic range above the receiver threshold defined in table 7.1, 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 Automatic Transmit Power Control (ATPC).

Table 5: 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 Receiver spurious emissions

At reference point C, the limit values of CEPT/ERC Recommendation 74-01 [21] shall apply.

Table 6: Void

5.4.3 BER performance

5.4.3.1 Single signal performance

For a single DS-CDMA 64 kbit/s signal, receiver BER thresholds (dBm) referred to point C of the system block diagram (figure 2) for BER of 10^{-3} and 10^{-6} shall be equal to or lower than those stated in table 7.1. These values do not include any contribution due to necessary signalling and synchronization overhead.

Table 7.1: BER performance thresholds

User bit rate (kbit/s)	RSL for BER 10^{-3}	RSL for BER 10^{-6}
64	-103	-101

5.4.3.2 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.

5.4.3.3 Maximum system loading

Manufacturers shall declare the maximum system loading for a system. The system performance should equal or exceed that given in the relevant table 7.3 at the declared maximum system loading.

The minimum number of simultaneous traffic channels for fully configured class A and class B systems is given in table 7.2.

Table 7.2: Minimum number of simultaneous 64 kbit/s traffic channels

Channel spacing	3,5 MHz	7,0 MHz	10,5 MHz	14 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	Minimum number of simultaneous 64 kbit/s traffic channels
A	20	40	60	80
B	8	16	24	32

Class A systems shall exceed the BER performance in tables 7.3 (a1), (a2), (a3) or (a4) for the relevant radio channel spacing and number of 64 kbit/s users.

Class B systems shall exceed the BER performance in tables 7.3 (b1), (b2), (b3) or (b4) for the relevant radio channel spacing and number of 64 kbit/s users.

NOTE: The nomenclature used for class of operation in tables 7.3 (a1) through (b4) 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.

Table 7.3 (a1): Maximum system loading - class A - 3,5 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
A2	2	-103	-101
A4	4	-103	-101
A6	6	-103	-101
A6	8	-102	-100
A10	10	-102	-100
A12	12	-102	100
A14	14	-101	-99
A16	16	-101	-99
A18	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 7.3 (a2): Maximum system loading - class A - 7,0 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
A4	4	-103	-101
A8	8	-103	-101
A12	12	-103	-101
A16	16	-102	-100
A20	20	-102	-100
A24	24	-102	-100
A28	28	-101	-99
A32	32	-101	-99
A36	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 7.3 (a3): Maximum system loading - class A - 10,5 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
A6	6	-103	-101
A12	12	-103	-101
A18	18	-103	-101
A24	24	-102	-100
A30	30	-102	-100
A36	36	-102	-100
A42	42	-101	-99
A48	48	-101	-99
A54	54	-101	-99
A60	60	-100	-98
A66	66	-100	-98
A72	72	-99	-97
A78	78	-98	-96
A84	84	-98	-96
A90	90	-97	-95

Table 7.3 (a4): Maximum system loading - class A - 14 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
A8	8	-103	-101
A16	16	-103	-101
A24	24	-103	-101
A32	32	-102	-100
A40	40	-102	-100
A48	48	-102	-100
A56	56	-101	-99
A64	64	-101	-99
A72	72	-101	-99
A80	80	-100	-98
A88	88	-100	-98
A96	96	-99	-97
A104	104	-98	-96
A112	112	-98	-96
A120	120	-97	-95

Table 7.3 (b1): Maximum loading capacity - class B - 3,5 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
B1	1	-103	-101
B2	2	-103	-101
B3	3	-102	-100
B4	4	-101	-99
B5	5	-101	-99
B6	6	-101	-99
B7	7	-99	-97
B8	8	-99	-97
B9	9	-98	-96
B10	10	-97	-95
B11	11	-97	-95
B12	12	-96	-94
B13	13	-95	-93
B14	14	-95	-93
B15	15	-94	-92
B16	16	-93	-91
B17	17	-93	-91
B18	18	-92	-90
B19	19	-91	-89
B20	20	-91	-89

Table 7.3 (b2): Maximum loading capacity - class B - 7,0 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
B2	2	-103	-101
B4	4	-103	-101
B6	6	-102	-100
B8	8	-101	-99
B10	10	-101	-99
B12	12	-100	-98
B14	14	-99	-97
B16	16	-99	-97
B18	18	-98	-96
B20	20	-97	-95
B22	22	-97	-95
B24	24	-96	-94
B26	26	-95	-93
B28	28	-95	-93
B30	30	-94	-92
B32	32	-93	-91
B34	34	-93	-91
B36	36	-92	-90
B38	38	-91	-89
B40	40	-91	-89

Table 7.3 (b3): Maximum loading capacity - class B - 10,5 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
B3	3	-103	-101
B6	6	-103	-101
B9	9	-102	-100
B12	12	-101	-99
B15	15	-101	-99
B18	18	-100	-98
B21	21	-99	-97
B24	24	-99	-97
B27	27	-98	-96
B30	30	-97	-95
B33	33	-97	-95
B36	36	-96	-94
B39	39	-95	-93
B42	42	-95	-93
B45	45	-94	-92
B48	48	-93	-91
B51	51	-93	-91
B54	54	-92	-90
B57	57	-91	-89
B60	60	-91	-89

Table 7.3 (b4): Maximum loading capacity - class B - 14,0 MHz channel

Class of operation	Number of 64 kbit/s users	RSL (dBm) at BER 10^{-3}	RSL (dBm) at BER 10^{-6}
B4	4	-103	-101
B8	8	-103	-101
B12	12	-102	-100
B16	16	-101	-99
B20	20	-101	-99
B24	24	-100	-98
B28	28	-99	-97
B32	32	-99	-97
B36	36	-98	-96
B40	40	-97	-95
B44	44	-97	-95
B48	48	-96	-94
B52	52	-95	-93
B56	56	-95	-93
B60	60	-94	-92
B64	64	-93	-91
B68	68	-93	-91
B72	72	-92	-90
B76	76	-91	-89
B80	80	-91	-89

5.4.4   Interference sensitivity

5.4.4.1   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 8.

For a declared loading of N signals applied to the receiver each at a level greater by 1 dB or 3 dB than the relevant level specified in table 7.3, an applied additional co channel interfere with uncorrelated like modulation in the same bandwidth at the relevant level specified in table 8 shall not cause the BER to exceed the relevant specified figure.

Table 8: Co-channel sensitivity

Threshold degradation →	-3		-6	
	1 dB	**3 dB**	**1 dB**	**3 dB**
Channel spacing (MHz) ↓	Interference level (dBm)	Interference level (dBm)	Interference level (dBm)	Interference level (dBm)
3,5	-112	-106	-112	-106
7	-109	-103	-109	-103
10,5	-108	-102	-108	-102
14	-106	-100	-106	-100

5.4.4.2   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 uncorrelated like-modulated signals shall be as in table 9.

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 7.3, an applied additional adjacent channel interfere with uncorrelated like modulation in the same bandwidth at the relevant level specified in table 9 shall not cause the BER to exceed the relevant specified figure.

Table 9: Adjacent channel sensitivity

Threshold degradation →	BER 10^{-3}		BER 10^{-6}	
	1 dB	**3 dB**	**1 dB**	**3 dB**
Channel spacing (MHz) ↓	Interference level (dBm)	Interference level (dBm)	Interference level (dBm)	Interference level (dBm)
3,5	-96	-90	-96	-90
7	-93	-87	-93	-87
10,5	-92	-88	-92	-88
14	-90	-84	-90	-84

5.5 Antenna port characteristics

5.5.1 RF interface

The RF interface at reference points C and C' of the RF system block diagram (figure 2) shall be coaxial 50 Ω.

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 (figure 2) shall be more than 15 dB at the reference impedance.

6 Types of subscriber equipment and network exchange interface

The equipment covered by the present document shall use standard interfaces, the more common of which are listed in table 10.

Table 10: 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 ITU-T V-series of Recommendations
Digital data port	ITU-T Recommendation G.703 [2], ITU-T V-series of Recommendations and ITU-T X-series of Recommendations
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 ITU-T V-series of Recommendations
Digital data port	ITU-T Recommendation G.703 [2], ITU-T V-series of Recommendations and ITU-T X-series of Recommendations
ISDN basic rate	ETS 300 012 [1]
ISDN + Analogue subscribers + leased lines	V5.1/V5.2 (EN 300 324 [18] / EN 300 347 [19])
2 MBit/s interface	ITU-T Recommendation G.703 [2]

7 Power supply, EMC, environmental and mechanical characteristics

7.1 Power supply

The equipment shall operate from one or more of the power supplies within the ranges specified in tables 11 and 12.

Table 11: Power supplies - dc

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

Table 12: Power supplies - ac

For 110 V ac nominal	99 V to 121 V	60 Hz $\pm$ 2 Hz
For 230 V ac nominal	207 V to 253 V	50 Hz $\pm$ 2 Hz (ETS 300 132 [10])

7.2 Environmental conditions

The equipment shall meet the environmental conditions set out in ETS 300 019 [9] which defines weather protected and non-weather protected locations 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 [9] classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [9] 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 in non-weather protected locations shall meet the requirements of ETS 300 019 [9], classes 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 classes 3.3, 3.4 and 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

The system shall operate under the conditions specified in EN 300 385 [12].

History

Document history			
V1.1.1	February 1998	Publication	
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