Draft EN 301 179 V1.1.1 (1998-04)

European Standard (Telecommunications series)

Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Frequency Hopping Code Division Multiple Access (FH-CDMA); Point-to-multipoint DRRS in the bands within the range 1 GHz to 3 GHz

European Telecommunications Standards Institute

Reference
DEN/TM-04058 (ax000ico.PDF)

Keywords
CDMA, DRRS, multipoint, radio, RLL,
transmission

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM), and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

Introduction

The main field of application of Point-to-Multipoint (P-MP) systems is to provide access to both public and private networks (Public Switched Telephone Network (PSTN), Private Data Network (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).

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.

P-MP systems are generally configured as Pre-Assigned Multiple Access (PAMA) radio 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 scope of the present document covers the following typical P-MP applications:

- voice;
- fax;
- voiceband data;
- telex;
- data up to 64 kbit/s;
- ISDN.

1.2 Frequency bands and channel arrangements

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 Recommendation T/R 13-01 [7] and ITU-R Recommendation F.1098 [20]. For the 2,4 GHz band, the ITU-R Recommendation F.701-2 [8] is applicable.

1.3 Access method

The standard covers Frequency Hopping - Code Division Multiple Access (FH-CDMA) systems.

NOTE: The method described in the present document applies slow frequency hopping DTR/TM-04038 [26], with a hopping period up to 5 msec. During the dwell time, several different links in the same area may operate on different sub-channels in a manner which resembles the characteristics and properties of FDMA systems. The sub-channel supporting each link may be further subdivided using frequency division, time division or a combination of both techniques. (The terms "hopping period", "dwell time" and "sub-channel" are defined in subclause 3.1).

1.4 Compatibility

The present document is not intended to ensure that a Central Station (CS) from one manufacturer will inter-operate with a Terminal Station (TS) or Repeater Station (RS) from another manufacturer.

2 Normative references

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case 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] 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 hierarchic 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 and V-series: "Telegraph modem for subscriber lines".

[7] CEPT T/R 13-01 (1993): "Preferred channel arrangements for fixed services in the range 1-3 GHz".

[8] ITU-R Recommendation F.701-2: "Radio frequency channel arrangements for analogue and digital P-MP radio systems operating in frequency bands in the range 1 350 to 2 690 GHz (1.5, 1.8, 2.0, 2.2, 2.4 and 2.6 GHz)".

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

[10] ETS 300 132: "Equipment Engineering; Power supply interface at the input to telecommunications equipment part 1: Operated by alternating current (ac) derived from direct current (dc) sources and part 2: Operated by direct current (dc)".

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

[12] ETS 300 385: "Radio Equipment and Systems (RES);ElectroMagnetic Compatibility (EMC) standard for digital fixed radio links and ancillary equipment with data rate around 2 Mbit/s and above".

[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 G729: "Coding of speech at 8kbit/s using conjugate-structure algebraic-code-excited linear-prediction (CS-ACELP)".

[17] 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".

[18] ETS 300 324: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Networks (AN)".

[19] ETS 300 347: "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Networks (AN)".

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

[21] ITU-T Recommendation G.723: "Speech coders".

[22] ITU-T Recommendation G131: "Control of talker echo".

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

[24] IEC 169-1: "Radio-frequency connectors".

[25] IEC 339: "General purpose rigid coaxial transmission lines and their associated flange connectors".

[26] DTR/TM-04038: "Transmission and Multiplex (TM); Digital Radio Relay Systems (DRRS); P-MP DRRS in the access network".

[27] ITU-R Recommendation F.1189: "Error performance objectives for constant bit rate digital path at or above the primary rate carried by digital radio-relay systems which may form part or all of the national portion of a 27 500 km hypothetical reference path".

[28] ITU-R Recommendation F.557-4 : "Availability objective for radio relay systems over a hypothetical reference circuit and a hypothetical reference digital path".

[29] ITU-T Recommendation G.826: "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

[30] ITU-T Recommendation G.827: "Availability parameters and objectives for path elements of international constant bit rate digital paths at or above the primary rate".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Radio Frequency channel (RF channel): A partition of a radio frequency band which may be assigned by the authorities in accordance with CEPT or ITU-R Recommendations on channel arrangement (loosely called "an individual channel" in CEPT T/R 13-01 [7]) (see figure 1).

channel spacing: The separation between the centre frequencies of neighbouring RF channels.

assigned band: The aggregation of all RF channels assigned to a FH-CDMA system. The assigned band may consist of several non-contiguous RF channels (see figure 1).

sub-channel: An integer sub-division of the RF channel(s) as determined by the equipment manufacturer (see figure 1).

Frequency hopping (FH): A spread spectrum technique whereby individual radio links are continually switched from one sub-channel to another. Such links are not constrained to a single RF channel.

dwell time: The duration of a transmission on a particular sub-channel.

transition time: The period between successive transmissions on different sub-channels during which no transmission is made.

hopping sequence: The sequence of sub-channels which a particular link follows.

hopping period: The time between the starts of successive transmissions on a different sub-channel. This is the sum of dwell time and transition time.

slow frequency hopping: A FH technique where the hopping period is larger than the symbol period.

round trip delay: The sum of the delays from points F to G and from G to F in figure 2, including any repeaters if appropriate.

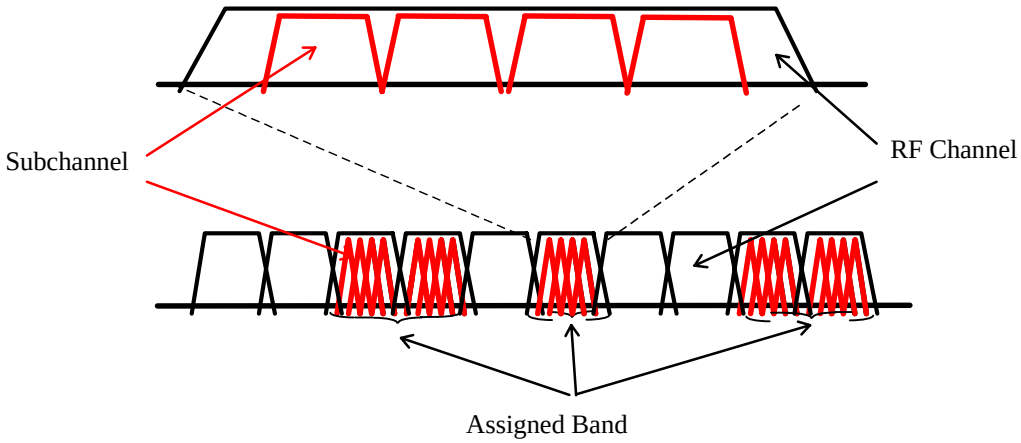


Figure 1: Relationship between "sub-channel", "RF channel" and "assigned band"

3.2 Symbols

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

dB	decibel
dBm	decibel relative to 1 mW
GHz	Gigahertz
Hz	Hertz
kbit/s	kilobits per second
kHz	kilohertz
Mbit/s	Millions of bits per second
MHz	Megahertz
ms	millisecond
mW	milliwatt
ppm	parts per million
Ω	ohms
s	seconds
V	Volts

3.3 Abbreviations

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

ac	alternating current
ATPC	Automatic Transmit Power Control
BER	Bit Error Ratio
BW	Bandwidth
CCS	Central Controller Station
CEPT	La Conférence Européenne des Administrations des Postes et Télécommunications
CRS	Central Radio Station
CS	Central Station
DAMA	Demand Assigned Multiple Access
CW	Continuous Wave
EMC	Electromagnetic Compatibility
EN	European Norm
ETS	European Telecommunication Standard
ETSI	European Telecommunications Standards Institute
F_0	Centre of an radio frequency channel
FH	Frequency Hopping
FH-CDMA	Frequency Hopping Code Division Multiple Access
ISDN	Integrated Services Digital Network

ITU	International Telecommunications Union
P-MP	Point-to-Multipoint
PAMA	Pre-Assigned Multiple Access
PDN	Private Data Network
PRBS	Pseudo Random Bit Sequence
PSTN	Public Switched Telephone Network
QDU	Quantisation Distortion Unit
RF	Radio Frequency
Rx	Receiver
RS	Repeater Station
RTPC	Remote Transmit Power Control
TE	Terminal Equipment
TS	Terminal Station
Tx	Transmitter

4 General system architecture

A system could consist of physical sub systems as follows (see figure 2).

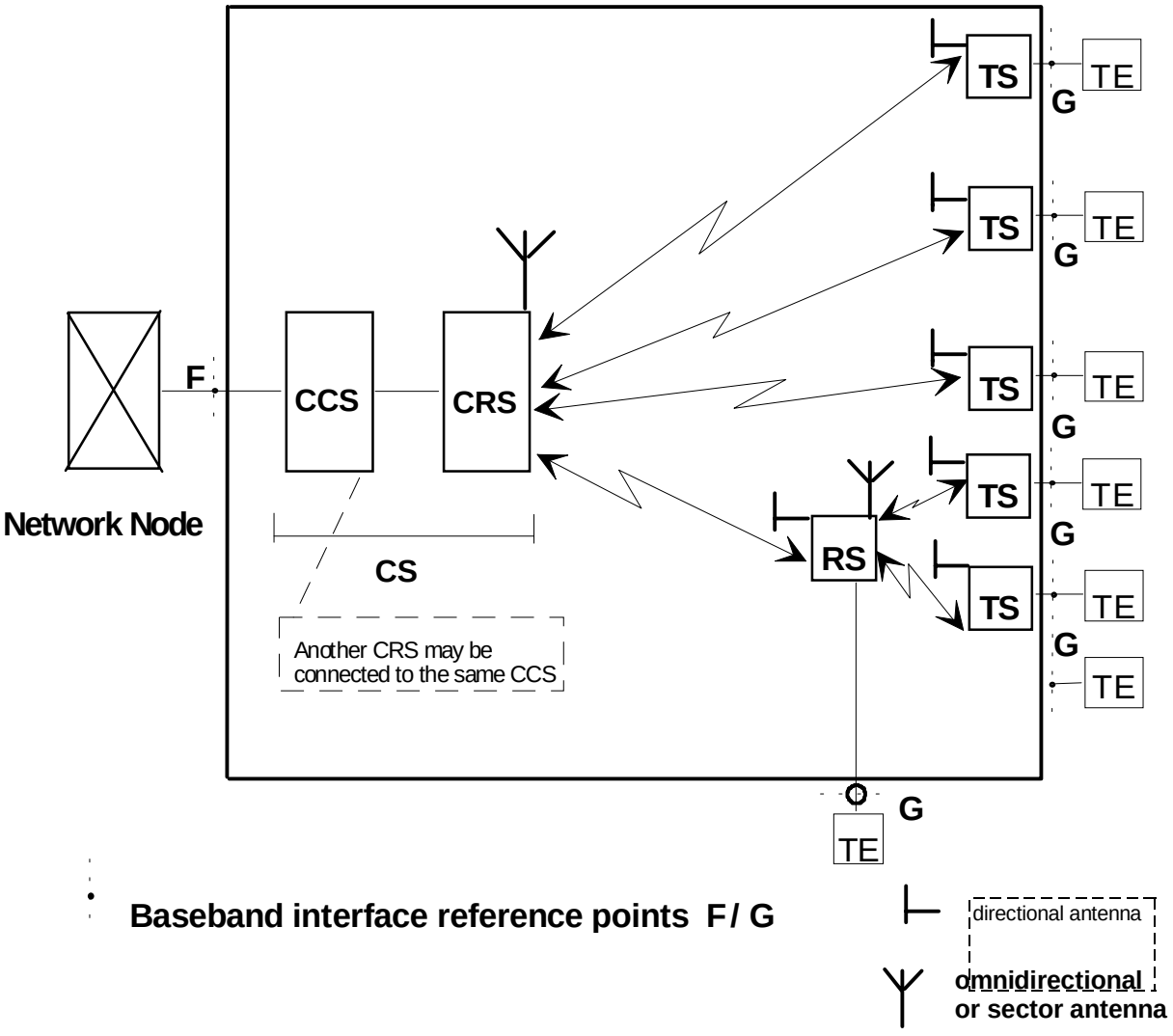


Figure 2: General system architecture

4.1 Sub-system components

- **TS**: Terminal station (outstations with subscriber interfaces). A TS may serve more than one Terminal Equipment (TE);
- **RS**: Repeater Station (radio repeater outstations with or without subscriber interfaces). A RS may serve one or more TS;
- **F**: Point of connection to the network node (such as a local switch);
- **G:** Point(s) of connection for subscriber equipment;
- **CS**: Central Station which may 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. More than one CRS may be controlled by one CCS.

The central station 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 P-MP 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 with system rate lower than 32×64 kbit/s, or equivalent, 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 [17] for the local grade portion of the digital connection.

Equipment with system rate equal to, or greater than, 32×64 kbit/s, or equivalent, shall be designed in order to meet network performance and availability requirements foreseen by ITU-T Recommendations G.826 [29] and G.827 [30] for the criteria defined in ITU-R Recommendations F.1189 [27] and F.557 [28] for the national 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 additional delay introduced by the system into the transmission network does not degrade the quality of telephone communication, compliance with ITU-T Recommendation G131 [22] shall be ensured.

4.2.3 Transparency and voice coding methods

The system shall be transparent: the exchange and the subscriber equipment (points F and G in figure 2) 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 [13] (which will permit full transparency and a direct digital interface to digital switches);
- 32 kbit/s: ITU-T Recommendation G.726 [14];
- 16 kbit/s: ITU-T Recommendation G.728 [15];
- 8 kbit/s: ITU-T Recommendation G.729 [16];
- 6,3 kbit/s: ITU-T Recommendation G.723 [21].

Other voice coding methods may be employed if the quality (measured for example in QDU or 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.

4.2.6 Frequency hopping characteristics

The hopping period shall not exceed 5 ms.

5 Radio characteristics

5.1 Frequency bands

Five frequency plans presently available to be allocated 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 band. Assignment of these frequencies is subject to the relevant (national) authorities.

5.2 Channel arrangement

Table 1: Frequency bands

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

The RF channel (or channels) comprising the assigned band shall (each) comply with one of the channel arrangements recommended in T/R 13-01 [7] or ITU-R Recommendation F.701 [8].

5.3 Maximum system loading and system capacity

The supplier shall declare the maximum number of simultaneous duplex 64 kbit/s traffic channels which the equipment is designed to carry for each channel spacing supported. Such declared capacity shall not be less than the values shown in table 2.

Table 2: System capacity

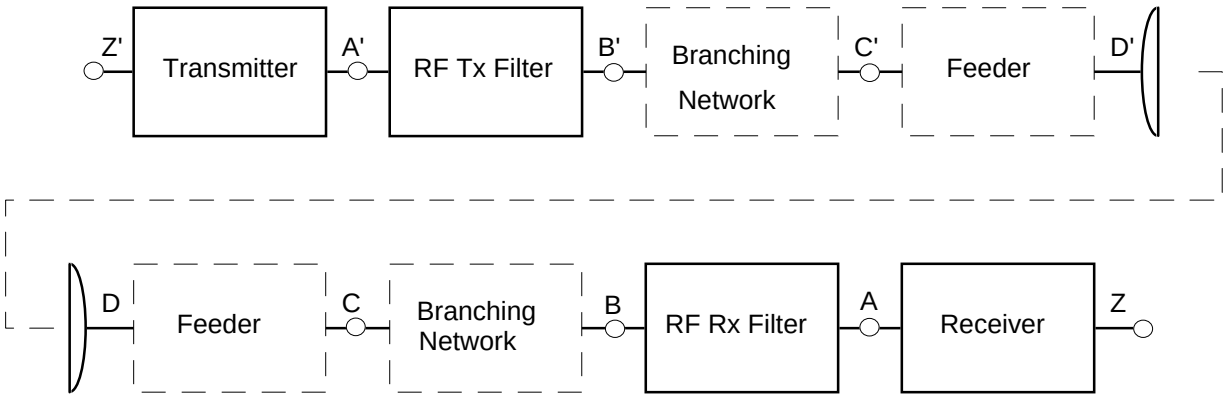
Channel spacing (MHz)	1,0	2,0	3,5	7,0	14,0
Minimum number of 64 kbit/s traffic channels	8	16	28	56	112

5.4 Transmitter characteristics

5.4.1 Tx power range

The output power for a fully loaded system shall not exceed 43 dBm at point C' of the RF System block diagram (figure 3). 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 PRBS test data signal (or lower rate if the system uses compressed voice techniques) to simulate traffic.



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

Figure 3: RF system block diagram

5.4.2 Transmit power control

5.4.2.1 Automatic Transmit Power Control (ATPC)

ATPC is an optional feature. Equipment with ATPC will be subject to manufacturer declaration of the ATPC ranges and related tolerances. Testing shall be carried out with output power levels corresponding to:

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

5.4.2.2 Remote Transmit Power Control (RTPC)

RTPC is an optional feature. Equipment with RTPC will be subject to manufacturer declaration of the RTPC ranges and related tolerances. Testing shall be carried out with output power levels corresponding to:

- RTPC set manually to the maximum and to the minimum values for system performance;
- RTPC set at a maximum provided output power for Tx performance;
- RF spectrum mask shall be verified at three points (lower medium and upper part of the assigned band) if applicable. Tx power control shall be set to the maximum value.

5.4.3 Spectrum mask

The spectrum mask is given in figure 4. 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 with all sub-channels in the RF channel occupied.

The spectrum measurement at point C' of RF system block diagram in figure 3, 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: Spectrum analyser settings

Resolution BW	Video BW	Sweep time
30 kHz	300 Hz	10 s
NOTE: Where practical, the spectrum analyser sweep is to be synchronized to the hopping sequence.		

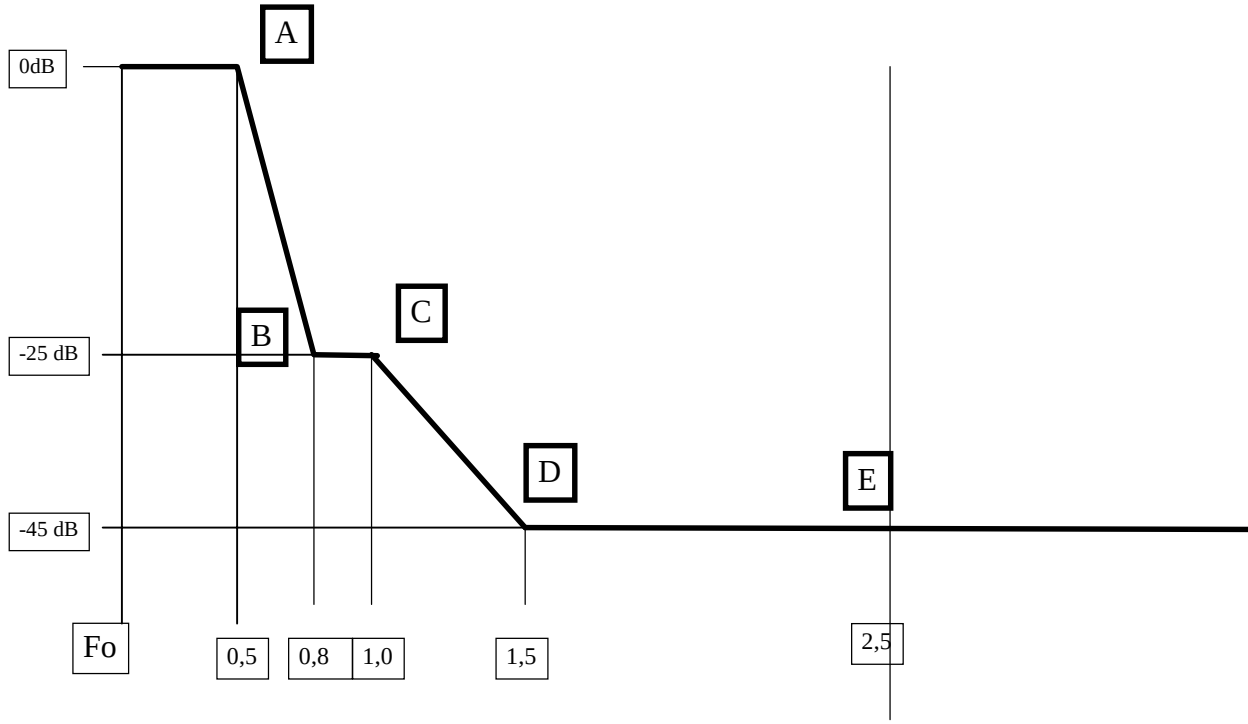


Figure 4: FH-CDMA spectrum mask normalized for channel spacing

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

5.4.4 Transmitter spurious emissions

For the purpose of the present document, transmitter spurious emissions are defined as emissions at frequencies which are outside the nominal carrier frequency ± 2,5 times the relevant channel spacing as shown in figure 5 below.

The limit values measured at point C' in figure 3 are defined in table 5.

Table 5: Maximum transmitter spurious emissions allowed for CRS, RS and TS.

From the edge of the defined spectrum mask ($F_0 \pm$ 250 % of the relevant channel spacing) to a frequency 56 MHz beyond this point.	-13dBm
9 kHz < f < (5 X F_0)	-50 dBm for CRS and RS co-located with CRS -40 dBm for TS and RS not co-located with CRS
NOTE: Spurious emissions to be measured in a 1 MHz resolution bandwidth for emissions above 1 GHz and in a 100 kHz resolution bandwidth for emissions falling between 30 MHz and 1 GHz.	

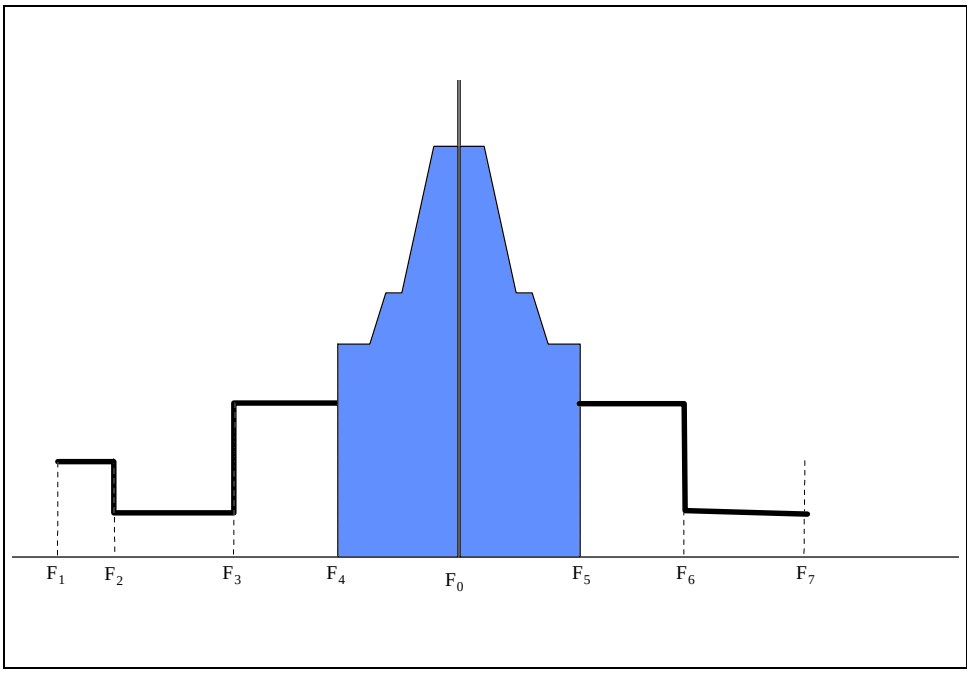


Figure 5: Spectrum mask for transmitter spurious emissions

Table 6: Frequency breakpoints for transmitter spurious emissions

F_1	9 kHz
F_2	1 GHz
F_3	F_0 - 250 % Channel Spacing - 56 MHz
F_4	F_0 - 250 % Channel Spacing
F_5	F_0 + 250 % Channel Spacing
F_6	F_0 + 250 % Channel Spacing + 56 MHz
F_7	$(5 \times F_0)$

5.4.5 Radio frequency tolerance

Maximum RF tolerance shall not exceed 20 ppm. This 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.

5.5 Receiver characteristics

5.5.1 Dynamic range

The dynamic range of the system covers the following:

- automatic gain control of the receiver;
- adjustment of output power;
- ATPC;
- RTPC.

The Bit Error Radio (BER) shall be less than 10^{-3} for a dynamic range which exceeds 60 dB. The exact value shall be declared by the manufacturer.

5.5.2 Spurious emissions

The limit values for receiver spurious emissions, measured at point C in figure 3, are given in tables 7 and 8 below, and shown in figure 6.

Table 7: CS equipment, including RS equipment without subscriber interfaces

9 kHz < f <(5 x F_0)	-50 dBm

Table 8: TS equipment, including RS equipment with subscriber interfaces

9 kHz < f <(5 x F_0)	-40 dBm

Spurious emissions to be measured in a 1 MHz resolution bandwidth for emissions above 1 GHz and in a 100 kHz resolution bandwidth for emissions falling between 30 MHz and 1 GHz.

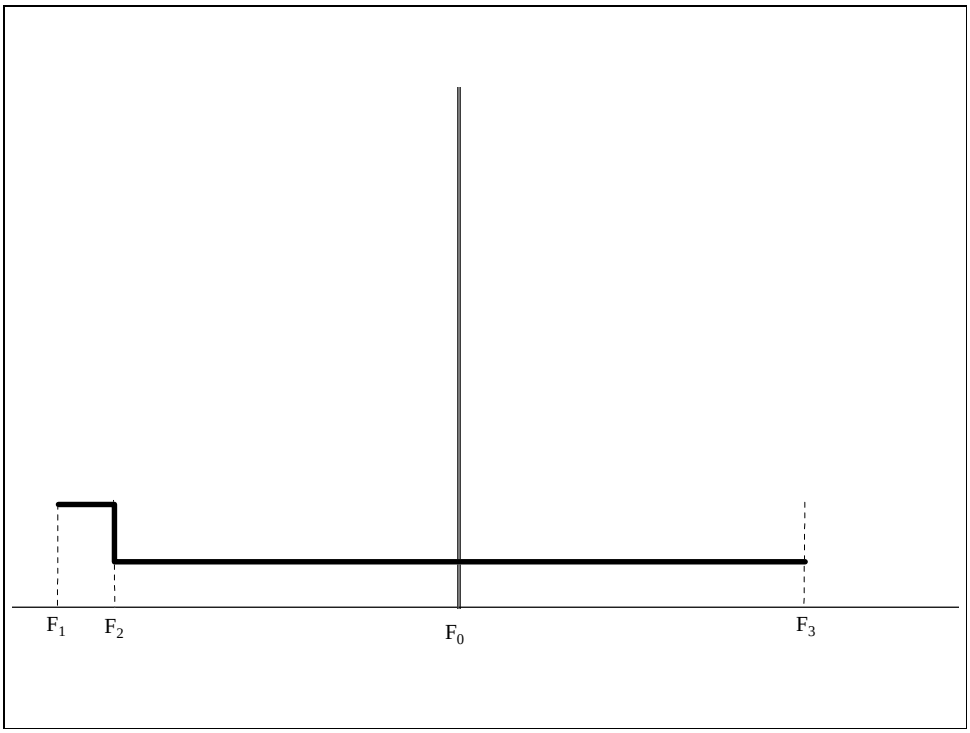


Figure 6: Spectrum mask for receiver spurious emissions

Table 9: Frequency breakpoints for receiver spurious emissions

F_1	9 kHz
F_2	1 GHz
F_3	(5 × F_0)

5.5.3 BER performance

With all sub-channels in the RF channel occupied, the BER versus receive signal power level, referred to point C of the system block diagram (figure 3) shall be equal to, or better than, the values in table 10.

Table 10: BER versus receiver signal level

Bit rate	BER 10^{-3}	BER 10^{-6}
≤ 1 Mbit/s	NOTE	NOTE
2 Mbit/s	-90 dBm	-86 dBm
4 Mbit/s	-87 dBm	-83 dBm
NOTE: For these systems the reference levels may be calculated from the following formulas: For BER = 10^{-3} (-93 + $10\log_{10}$[bit rate Mbit/s]) dBm For BER = 10^{-6} (-89 + $10\log_{10}$[bit rate Mbit/s]) dBm		

5.5.4 Interference sensitivity

5.5.4.1 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 3.

For a system with all sub-channels in the RF channel occupied, each at a level greater by 1 or 3 dB than the level specified in table 10, an applied additional co-channel interferer with uncorrelated like-modulation, at the levels indicated in table 11, shall not cause the BER to exceed 10^{-6}.

Table 11: Co channel sensitivity for BER = 10^{-6}

Threshold Degradation →	1 dB	3 dB
Channel Spacing MHz ↓	Interference level (dBm)	Interference level (dBm)
1,0	-117	-111
2,0	-114	-108
3,5	-112	-106
7,0	-109	-103
14,0	-106	-100

5.5.4.2 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 3.

The limits of adjacent channel interference for an uncorrelated like-modulated signal shall be as in table 12.

Table 12: Adjacent channel sensitivity for BER = 10^{-6}

Threshold Degradation →	1 dB	3 dB
Channel Spacing MHz ↓	Interference level (dBm)	Interference level (dBm)
1,0	-101	-95
2,0	-98	-92
3,5	-96	-90
7,0	-93	-87
14,0	-90	-84

5.5.4.3 Broadband CW interference rejection capability

For a receiver operating at the received signal level specified in subclause 5.5.3 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 up to 450 % of the channel spacing either side of the assigned band, 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.

5.6 Antenna port characteristics

5.6.1 RF interface

For equipment without an integral antenna, the RF interface at reference points C and C' of the RF system block diagram (figure 3) shall be coaxial 50 Ω. The connectors shall conform with IEC 169-1 [24] or IEC 339 parts 1 and 2 [25].

5.6.2 Return loss

For equipment without an integral antenna, the return loss at reference points C and C' of the RF system block diagram (figure 3) 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 one or more ETSI or ITU standardized interfaces, the more common of which are listed in table 13.

Table 13: 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 and V-series [6]
Digital data port	ITU-T Recommendation G.703, 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 and V Series [6]
Digital data port	ITU-T Recommendation G.703, 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 [18]/ ETS 300 347 [19]) ITU-T Recommendation G.703 [2]
NOTE: Further ITU/ETSI standardized 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 table 14 and table 15.

Table 14: Power Supplies - dc

Nominal voltage	Voltage range
12	10,8 V to 13,6 V
24	21,8 V to 28,1 V
48	40,5 V to 57 V

Table 15: Power Supplies - alternating current (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

Power supply interfaces for 220 V ac and for 48 V DC shall be in accordance with the characteristics foreseen by ETS 300 132 part 1 and part 2 [10] respectively.

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], class 4.1 or 4.1E.

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

Weather-protected equipment conforming to class 3.3, 3.4, 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 Conditions

Equipment with a capacity of 2 Mbit/s and above shall operate under the conditions of ETS 300 385 [12]. For lower capacities the subject is under study, however ETS 300 339 [23] shall apply on a provisional basis. In the second case, immunity criteria will be stated by the supplier for conformance test purposes.

History

Document history				
V1.1.1	April 1998	Public Enquiry	PE 9833:	1998-04-17 to 1998-08-14