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Transmission and Multiplexing (TM); Time Division Multiple Access (TDMA) point-to-multipoint digital systems in the 1 to 3 GHz band

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 92 94 42 00 - Fax: +33 93 65 47 16

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Foreword

This draft European Telecommunication Standard (ETS) has been prepared by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI) and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this ETS (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 the Public Switched Telephone Network (PSTN) and private networks (Private Digital network (PDN)), particularly for remote subscribers. By means of P-MP systems the network service area may be extended to cover both distant and scattered subscriber locations.

These remote subscribers, in a similar manner to the city subscriber, 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 standardised user network interfaces (2-wire loop, data, ...).

P-MP applications in the metropolitan and urban environment are mainly for the provision of new data services for business subscribers and for the extension of ISDN services to local subscribers.

The frequency bands below 3 GHz are particularly suitable for the extension of telecommunications services to distant rural and suburban subscribers.

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

P-MP systems are generally, but not necessarily, configured as pre-assigned systems or as Demand Assigned Multiple Access (DAMA) Radio Systems.

The essential features of a typical P-MP Demand Assigned Multiple Access Radio Systems 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 topology. Moreover, only a small number of sites are required for these installations, thus facilitating rapid implementation and minimising maintenance requirements of the systems.

Concentration means that N subscribers can share n channels (N 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" is derived from the fact that every subscriber has access to every channel (instead of a fixed assignment as in most multiplex systems). When a call is initiated one of the available channels 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 telephone communicate with each other without being aware of the radio link.

1 Scope

1.1 Applications

The scope of this European Telecommunication Standard (ETS) covers the following Point-to-Multipoint (P-MP) applications:

- voice;
- telex;
- low speed data (up to 64 kbit/s);
- Integrated Sevices Digital Network (ISDN) (basic rate access).

1.2 Frequencies

This ETS covers fixed services operating in the 1,5 GHz, 2,2 GHz, 2,4 GHz and 2,6 GHz bands and having the frequency plans as given in CEPT Recommendation T/R 13-01 [7] for 1,5 GHz, 2,2 GHz and 2,6 GHz bands. For the 2,4 GHz band, the ITU-R Recommendation 701 [8] is applicable.

1.3 Access method

The ETS covers Time Division Multiple Access (TDMA) systems.

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

[1] ETS 300 012 (1992): "Transmission and Multiplexing (TM), Integrated Sevices Digital Network (ISDN); Basic user-network interface Layer 1 specification and test principles".

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

[3] ITU-T Recommendation G.712: "Transmission performance characteristics of pulse code modulation".

[4] ITU-T Recommendation G.713: "Performance characteristics of PCM channels between 2-wire interfaces at voice frequencies".

[5] CCITT Recommendation G.821: "Error performance of an international digital connection forming part of an integrated services digital network".

[6] CCITT Recommendation R.20 and V-series: "Telegraph modem for subscriber lines".

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

[8] ITU-R recommendation 701: "Radio-frequency channel arrangements for analogue and digital point-to-multipoint radio systems operating in frequency bands in the range 1.427 to 2.690 GHz (1.5, 1.8, 2.0, 2.2, 2.4 and 2.6 GHz)".

[9] ETS 300 019 Parts 1 and 2 Sub-parts 0 to 7 (1992/1994): "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

[10] prETs 300 132 Parts 1 and 2: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment interface".

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

[12] ETS 300 385 (1993): "Radio Equipment and Systems (RES); EMC standard for digital fixed radio links and ancillary equipment with data rates at around 2 Mbit/s and above".

[13] ETS 300 324 Parts 1 to 5, 7 (1994): "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE) V5.1 interface for the support of Access Network (AN)".

[14] ETS 300 347 Parts 1 and 2 (1994): "Signalling Protocols and Switching (SPS); V interfaces at the digital Local Exchange (LE) V5.2 interface for the support of Access Network (AN)".

3 Symbols and abbreviations

For the purposes of this ETS the following symbols and abbreviations apply:

3.1 Symbols

Hz	Herz
kHz	kilo Herz
MHz	Mega Herz
GHz	Giga Herz
kbit/s	kilo bits per second
Mbit/s	Mega bits per second
ms	millisecond
dB	deciBel
dBm	deciBel relative to 1 milliwatt

3.2 Abbreviations

CS	Central Station
CCS	Central Controller Station
CRS	Central Radio Station
PRBS	Pseudo-Random Bit Sequence
TMN	Telecommunications Management Network
TS	Terminal Station
RS	Repeater Station

4 General system architecture

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

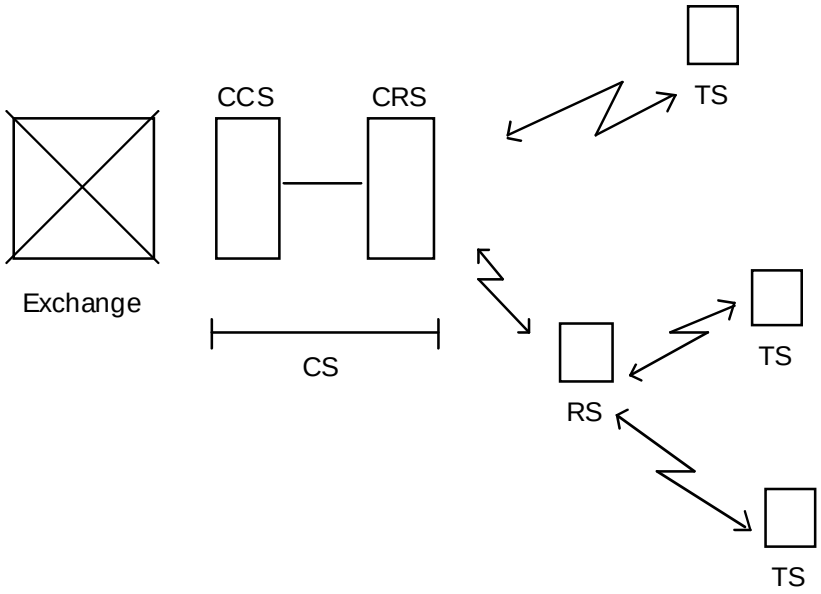


Figure 1: General system architecture

4.1 Sub-system types

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

- the exchange unit, also called Central Controller Station (CCS) - (interface to the local switch); and
- the radio unit, also called Central Radio Station (CRS) - (central baseband / radio transceiver).

TS: Terminal station (outstations with subscriber interfaces).

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

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 (Repeater Stations (RS) or Terminal Stations (TS)) by microwave transmission paths.

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

Terminal stations are situated as close as possible to the "centre of gravity" of the subscriber locations. They interface directly with the subscriber loops.

The general characteristics which are typical for point-to-multipoint systems are considered in this ETS. These characteristics have been categorised under four headings:

- system;
- radio;
- type;
- power supply and environmental characteristics.

4.2 System characteristics

4.2.1 System capacity

The system traffic carrying capacity shall be n x 2 Mbit/s (n = 1 or 2).

4.2.2 Transmission error performance

Transmission performance shall comply with CCITT Recommendation G.821 [5].

4.2.3 Round trip delay

The round trip delay (including transmission delay) shall not exceed 20 ms for a voice encoded 64 kbit/s time slot.

4.2.4 Transparency

The system shall be fully transparent: the exchange and the telephone subscriber communicate with each other without being aware of the radio link.

4.2.5 Telecommunications Management Network (TMN) interface

The TMN interface, if any, should be in accordance with ITU-T Recommendation G773 [11].

5 Radio characteristics

5.1 Frequency bands

Five frequency plans are used for digital point-to-multipoint systems. Two in the 1,5 GHz band, one each in the 2,2 GHz, 2,4 GHz and the 2,6 GHz band.

5.2 Channel arrangement

Table 1: Frequency bands

frequency band	band limits	Transmit/receive spacing
1,5 GHz (I)	1 350-1 375 and 1 492-1 517 MHz	142 MHz
1,5 GHz (II)	1 375-1 400 and 1 427-1 452 MHz	52 MHz
2,2 GHz	2 025-2 110 and 2 200-2 290 MHz	175 MHz
2,4 GHz	2 300-2 500 MHz	94 MHz
2,6 GHz	2 520-2 670 MHz	74 MHz

Table 2: Channel spacing

Minimum bit rate (Mbit/s)	2	4
Channel spacing (MHz)	1,75/2	3,5

5.3 Transmitter characteristics

5.3.1 TX power range

Maximum output power (averaged during the emission state of the transmitter) up to 35 dBm ± 1 dB at point C' of system block diagram (figure 2).

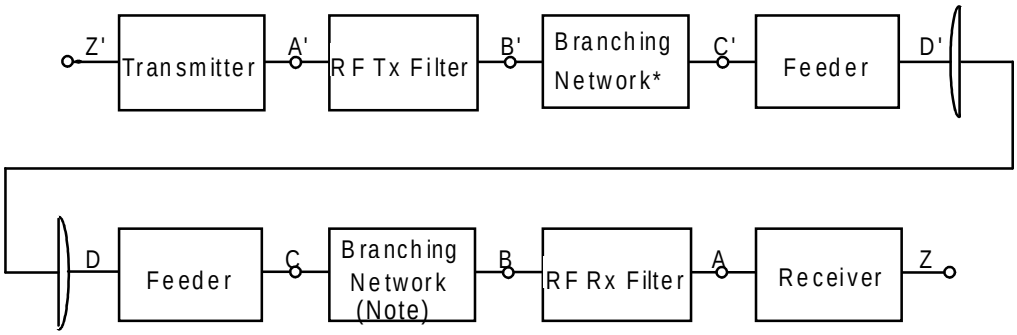
If for proper operation of the system, a lower transmitter output power is required, then an internal or external means of adjustment shall be provided.

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 transmitted power is then modulated with a Pseudo-Random Bit Sequence (PRBS) test data signal.

Two different measurement methods can be used:

- spectrum analyser with resolution Bandwidth (BW) and video BW greater than 1 MHz;
- power meter.

NOTE: Use of a peak power meter is suitable when measuring the output power of transmitters operating in a burst mode.



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

Figure 2: Radio Frequency (RF) block diagram

5.3.2 Spectrum 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 fully loaded system, i.e. "all trunks busy" or "continuous mode", eg. PRBS.

The spectrum measurement at point C' of the system block diagram shall be performed with the "max. hold" function selected on the spectrum analyser.

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.

Res. BW	Video BW	Sweep time
30 kHz	300 Hz	10 s

5.3.3 Transmitter spurious emissions

For the purposes of this ETS spurious emissions are defined as emissions at frequencies which are outside the nominal carrier frequency ± 2,5 times the relevant channel spacing.

The frequency range in which the spurious emission specification is to apply is 30 MHz to 10 GHz. The limit value measured at point C' is: ≤ -60 dBm.

NOTE: The value of -60 dBm may be considered provisional. A decision from CEPT is pending on this issue.

For the purposes of this ETS the measuring bandwidth is in the range 100 kHz to 120 kHz.

Within the exclusion bandwidth defined above, the unwanted emission level shall not exceed the limits fixed by the relevant spectrum mask.

5.3.4 RF frequency tolerance

All spectrum masks include an allowance for frequency stability and accuracy, which shall not exceed ± 20 ppm.

5.4 Receiver characteristics

5.4.1 Input level range

The input level range shall be greater than 40 dB above the threshold level for a BER of 10^{-3} referred to point C of the system block diagram (figure 2).

5.4.2 Spurious emissions

For the purposes of this ETS spurious emissions are defined as emissions at frequencies which are outside the nominal carrier frequency ± 2,5 times the relevant channel spacing.

The frequency range in which the spurious emission specification is to apply is 30 MHz to 10 GHz. The limit values measured at point C' is: ≤ -60 dBm.

NOTE: The value of -60 dBm may be considered provisional. A decision from CEPT is pending on this issue.

For the purposes of this ETS the measuring bandwidth is in the range 100 kHz to 120 kHz.

Within the exclusion bandwidth defined above the unwanted emission level shall not exceed the limits fixed by the relevant spectrum mask.

5.4.3 BER performance

BER versus receive signal power level, referred to point C of the system block diagram (figure 2) shall be equal, to or better than the values in table 4:

Table 4: BER versus receiver signal level

Bit rate	BER 10^{-3}	BER 10^{-6}
2 Mbit/s	-92 dBm	-88 dBm
4 Mbit/s	-89 dBm	-85 dBm

5.4.4 Interference sensitivity

5.4.4.1 Adjacent channel interference

Adjacent channel selectivity is defined as, the ability of the receiver to receive a wanted signal in the presence of a like unwanted signal which is one channel away.

The two signals shall be connected to the receiver input via a combiner, so that the impedance is matched to the nominal impedance.

The wanted signal shall be tuned to the receiver's nominal frequency and be modulated with a PRBS signal. The interfering signal shall be turned off while the wanted signal is adjusted to the level corresponding to BER = 10^{-6} as specified in table 4.

The interfering signal shall be tuned one channel away from the wanted signal and be modulated with a PRBS signal which is un-correlated to the wanted signal.

The interfering signal shall be adjusted to the same level as the wanted signal. The BER shall not be greater than 10^{-5}.

Measurement on both sides of the nominal frequency shall be carried out.

5.4.4.2 Co channel interference

Co-channel selectivity is defined as, the ability of the receiver to receive a wanted signal in the presence of a like unwanted signal on the same frequency.

The two signals shall be connected to the receiver input via a combiner, so that the impedance is matched to the nominal impedance of the system.

The wanted signal shall be tuned to the receiver's nominal frequency and modulated with a PRBS signal.

The interfering signal shall be turned off while the wanted signal is adjusted to the level corresponding to BER = 10^{-6} as specified in table 4.

The interfering signal shall be tuned to the same frequency as the wanted signal and modulated with a PRBS signal which is uncorrelated to the wanted signal.

The interfering signal shall then be injected at a level which is 23 dB below the wanted signal.

The BER shall not be greater than 10^{-5} .

5.4.5 Image frequency rejection

Image frequency rejection shall be greater than 75 dB.

5.5 RF equipment port

5.5.1 RF interface

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

5.5.2 Return loss

The return loss at reference points C and C' of the system block diagram (figure 2) shall be more than 18 dB at the reference impedance.

6 Types of services / subscriber and exchange interfaces

The following table (table 5) lists a range of interfaces for various voice and data services. At least one of these interfaces shall be implemented in a point-to-multipoint system covered by this ETS.

Table 5: Types of interfaces/ranges

Interface	Proposed Standards
Subscriber Interfaces	
Analogue (2 wires)	ITU-T Recommendation G.713 [4]
Analogue (4 W + E & M)	ITU-T Recommendation G.712 [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 G.713 [4]
Analogue (4 W + E & M)	ITU-T Recommendation G.712 [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 [13] / ETS 300 347 [14])
Synchronisation (Note)	Systems shall include methods enabling internal and external synchronisation.
NOTE: The free running clock frequency shall not deviate more than 50 ppm from the nominal value. Moreover it shall be possible to synchronise the clock with an incoming timing signal that deviates 50 ppm from the nominal value (reference can be made to CCITT Recommendation G.703 [2]).	

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 6 and 7.

Table 6: Power supplies - DC

For 12 V DC nominal:	+10,8 to +13,6 V
For 24 V DC nominal:	-21,8 to -28,1 V
For 48 V DC nominal:	-40,5 to -57,0 V (Note)
For 60 V DC nominal:	-50.0 to -72,0 V (Note)

Table 7: Power supplies - AC

For 110 V AC nominal:	99 to 121 V	60 Hz ±2 Hz
For 230 V AC nominal:	207 to 253 V	50 Hz ±2 Hz (note)

NOTE: In compliance with 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 severities.

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 within 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 while class 4.1E applies to all ETSI countries.

Weather protected equipment conforming to class 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 this ETS.

7.3 Electromagnetic compatibility conditions

The matter is under study in ETSI TM4, RES 9 and CEPT.

For those aspects of EMC not specified in this ETS the conditions of ETS 300 385 [12] shall apply.

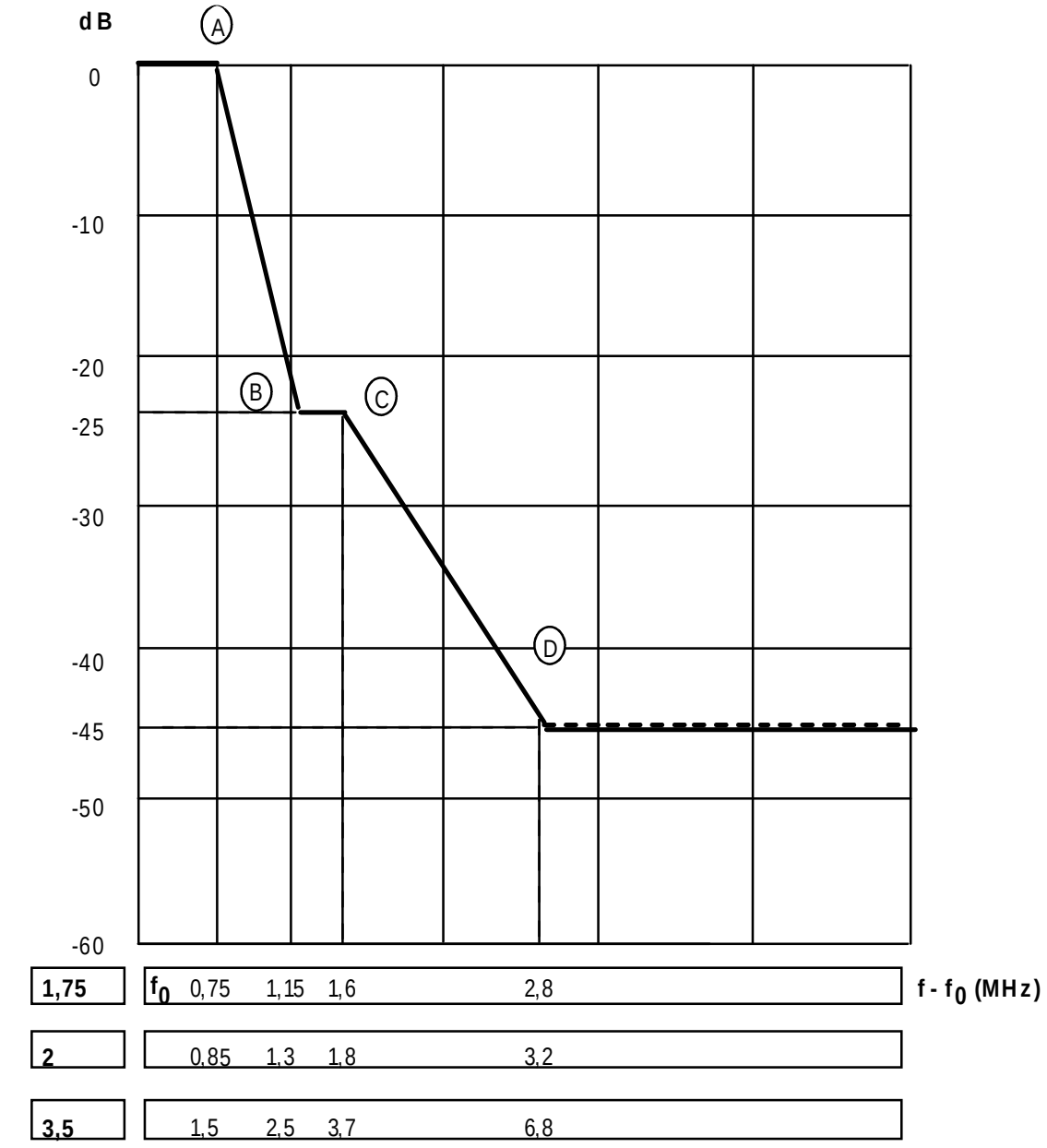


Figure 3: Power spectrum mask (fo = nominal carrier frequency)

History

Document history		
July 1995	Public Enquiry	PE 88: 1995-07-24 to 1995-11-17
May 1996	Converted into Adobe Acrobat Portable Document Format (PDF)	