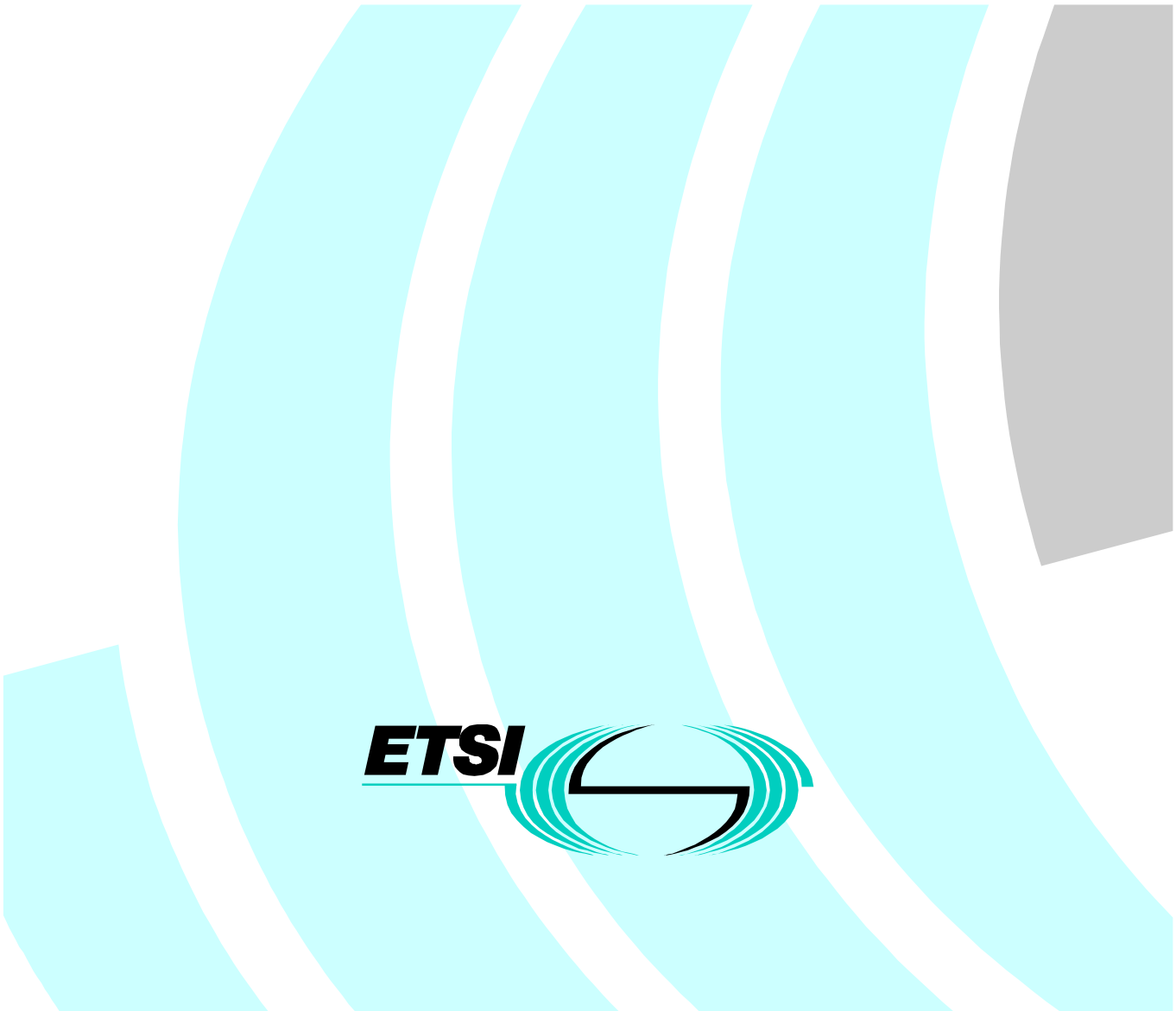
# EN 300 197 V1.2.2 (1998-11)

*European Standard (Telecommunications series)*

# Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Parameters for DRRS for the transmission of digital signals and analogue video signals operating at 38 GHz



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# Foreword

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

The present document, together with ETS 300 385 is intended to become a Harmonized Standard, the reference of which is intended to be published in the Official Journal of the European Communities, referencing Council Directive 89/336/EEC (EMC Directive).

The present document specifies the minimum performance parameters for radio equipment operating in the frequency ranges as detailed in subclause 4.1.1.

In addition to a complete revision in certain areas, the present document (equivalent to Edition 2 of ETS 300 197) incorporates, where necessary, changes made in Amendment 1 (1994) and Amendment 2 (1997).

Amendment 2 was produced by the Radio Equipment and Systems (RES) Technical Committee and consists of:

- annex B; the technical specifications relevant to the EMC Directive;
- annex C; the ERC Decision ERC/DEC/(98)08 which references the technical specifications in the present document for inclusion in national approval regulations.

| **National transposition dates** | |
|---|---|
| Date of adoption of this EN: | 5 December 1997 |
| Date of latest announcement of this EN (doa): | 31 May 1998 |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 30 November 1998 |
| Date of withdrawal of any conflicting National Standard (dow): | 30 November 1998 |

# 1 Scope

The present document specifies the minimum performance parameters for terrestrial digital and analogue fixed service radio communications equipments operating in the 38 GHz frequency band and incorporates, where necessary, changes made in Amendment 1 (1994) and contains a complete revision in the areas of:

- Electromagnetic Compatibility (EMC) standardization (i.e. ETS 300 385 [11] and ETS 300 339 [10] where applicable);
- emissions and immunity at antenna port standardization activity (under study in TM4), new revised ITU-R Recommendation SM.329-7 [20] and the forthcoming CEPT Recommendation on spurious emissions;
- conformance test standardization activity of test methods and test reports (i.e. EN 301 126-1 [2]).

The present document does not cover aspects related to test procedures and test conditions which are in the scope of EN 301 126-1 [2].

Digital systems are intended to be used for point-to-point connections in local and regional networks at data rates between 2 Mbit/s and Synchronous Transport Module, level 1 (STM-1). Typical applications include:

a) customer connections;

b) Integrated Services Digital Network (ISDN) extension;

c) mobile base station connections.

Digital systems considered in the present document will be able to meet the performance objectives of the ITU-R national portion of the reference path, i.e. ITU-R Recommendation F.1189 [17] and the performance objectives detailed in ITU-T Recommendation G.826 [29].

Analogue systems are intended to be used in local television (TV) point-to-point contribution and point-to-multipoint distribution.

The parameters to be specified fall into two categories:

a) those that are required to provide compatibility between channels from different sources of equipment on the same route, connected to separate antennas;

b) parameters defining the transmission quality of the proposed system.

The present document deals with Radio Frequency (RF) and baseband characteristics relevant to low, medium and high capacity Plesiochronous Digital Hierarchy (PDH) transmission systems, sub-STM-1 and STM-1 Synchronous Digital Hierarchy (SDH) transmission systems. Antenna/feeder system requirements are covered in ETS 300 833 [3].

As the maximum transmission rate in a given bandwidth depends on system spectral efficiency, different equipment classes are defined:

Class 1: equipment performance based on typically 2-states modulation scheme (e.g. 2-FSK (Frequency-Shift Keying), Gaussian Minimum Shift Keying (GMSK) with discriminator detection, or equivalent);

Class 2: equipment performances based on typically 4-states modulation scheme (e.g. 4-FSK, 4 - QAM (Quadrature Amplitude Modulation), or equivalent);

Class 3: equipment performances based on typically 16-states modulation scheme (e.g. 16-QAM, or equivalent).

Some equipment types may benefit from some performance improvement due to the technology gap; for this reason two grades of system performance, grade A and grade B are provided.

Safety aspects are outside the mandate of ETSI and they will not be considered in the present document.

# 2 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.

In the case of undated references, the time frame of application and new certification procedures for new releases of these normative references next to the date of the first public enquiry of the present document or to the first certification of the equipment shall be agreed between the supplier and the regulatory authority. These new certification procedures will cover in any case only the parameters subject to changes from the on going release during the previous certification.

[1] CEPT Recommendation T/TR 12-01: "Harmonized Radio Frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 37 GHz - 39,5 GHz".

[2] EN 301 126-1 (1997): "Transmission and Multiplexing (TM); Conformance testing for Digital Radio Relay Systems (DRRS); Part 1: Point-to-point equipment parameters".

[3] ETS 300 833: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Antennas used in point-to-point DRRS operating in the frequency band 3 to 60 GHz".

[4] ITU-R Recommendation F.746: "Radio-frequency channel arrangements for radio-relays systems".

[5] ETS 300 645: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) radio relay equipment; Information model for use on Q-interfaces".

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

[7] ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac)".

[8] ETS 300 132-2: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)".

[9] ETS 300 233: "Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate".

[10] ETS 300 339: "Radio Equipment and Systems (RES); General Electro-Magnetic Compatibility (EMC) for radio equipment".

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

[12] ETS 300 635: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); Radio specific functional blocks for transmission of Mx STM-N".

[13] ETS 300 785: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH); SDH radio specific functional blocks for transmission of M x sub-STM-1".

[14] ITU-R Recommendation F.750: "Architectures and functional aspects of radio-relay systems for SDH-based networks".

[15] ITU-R Recommendation F.751: "Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks".

[16] ITU-R Recommendation F.1102: "Characteristics of radio-relay systems operating in frequency bands above about 17 GHz".

[17] ITU-R Recommendation F.1189: "Error-performance objectives for constant bit rate digital paths 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".

[18] ITU-R Recommendation F.1191: "Bandwidths and unwanted emissions of digital radio-relay systems".

[19] ITU-R Recommendation P.530-6: "Propagation data and prediction methods required for the design of terrestrial line-of-sight systems".

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

[21] ITU-T Recommendation G.703 (1991): "Physical/electrical characteristics of hierarchical digital interfaces".

[22] ITU-T Recommendation G.704 (1995): "Synchronous frame structures used at 1 544, 6 312, 2 048, 8 488 and 44 736 kbit/s hierarchical levels".

[23] ITU-T Recommendation G.707 (1996): "Network node interface for the synchronous digital hierarchy (SDH)".

[24] ITU-T Recommendation G.773 (1993): "Protocol suites for Q-interfaces for management of transmission systems".

[25] ITU-T Recommendation G.781 (1994): "Structure of Recommendations on equipment for the synchronous digital hierarchy (SDH)".

[26] ITU-T Recommendation G.782 (1994): "Types and general characteristics of synchronous digital hierarchy (SDH) equipment".

[27] ITU-T Recommendation G.783 (1994): "Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks".

[28] ITU-T Recommendation G.784 (1994): "Synchronous digital hierarchy (SDH) management".

[29] ITU-T Recommendation G.826 (1993): "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

[30] ITU-T Recommendation G.861 (1996): "Principles and guidelines for the integration of satellite and radio systems in SDH transport networks".

[31] ITU-T Recommendation G.957 (1995): "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".

[32] ITU-T Recommendation I.412 (1988): "ISDN user-network interfaces - Interface structures and access capabilities".

[33] ITU-T Recommendation O.151 (1992): "Error performance measuring equipment operating at the primary rate and above".

[34] ITU-T Recommendation O.181 (1996): "Equipment to assess error performance on STM-N interfaces".

[35] TR 101 036-01 V1.1.2: "Transmission and Multiplexing (TM); Generic wordings for standards on Digital Radio Relay System (DRRS) characteristics; Part 1: General aspects and point-to-point equipment parameters".

[36] ITU-R Recommendation F.403: "Intermediate frequency characteristics for the interconnection of analogue radio-relay systems".

# 3 Symbols and abbreviations

## 3.1 Symbols

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

| | |
|---|---|
| dB | decibel |
| dBi | decibel relative to isotropic radiator |
| dBm | decibel relative to 1 mW |
| dBq0ps | decibel quasi-peak weighted relative to test tone reference level |
| dBu | decibel relative to 1microVolt |
| dBW | decibel relative to 1 W |
| GHz | GigaHertz |
| kHz | kiloHertz |
| Mbit/s | Mega-bits per second |
| MHz | MegaHertz |
| ppm | parts per million |
| ns | nanosecond |
| mW | milliWatt |
| Ω | Ohm |

## 3.2 Abbreviations

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

| | |
|---|---|
| ac | alternating current |
| ATPC | Automatic Transmit Power Control |
| AU | Administrative Unit |
| BB | Base Band |
| BBER | Background BER |
| BER | Bit Error Ratio |
| BWe | evaluation BandWidth (resolution bandwidth in which spectrum components are measured) |
| C/I | Carrier to Interference ratio |
| CEPT | Conférence des Administrations Européennes des Postes et Télécommunications |
| CMI | Coded Mark Inversion |
| CW | Continuous Wave |
| dc | direct current |
| DRRS | Digital Radio Relay Systems |
| EIRP | Equivalent Isotropically Radiated Power |
| EMC | ElectroMagnetic Compatibility |
| FSK | Frequency-Shift Keying (modulation) |
| GMSK | Gaussian Minimum Shift Keying (modulation) |
| IEC | International Electrotechnical Committee |
| IF | Intermediate Frequency |
| IPI | Inter-Port Isolation |
| ISDN | Integrated Services Digital Network |
| ITU-R | International Telecommunication Union-Radiocommunications standardization sector |
| ITU-T | International Telecommunication Union-Telecommunications standardization sector |
| LO | Local Oscillator |
| PAL | Phase Alternate Line |
| PDH | Plesiochronous Digital Hierarchy |
| PRBS | Pseudo Random Binary Sequence |
| QAM | Quadrature Amplitude Modulation |
| RES | ETSI technical committee-Radio Equipment and Systems |
| RF | Radio Frequency |
| RFC | Remote Frequency Control |
| RL | Return Loss |
| RSL | Receive Signal Level |
| RTPC | Remote Transmit Power Control |

| | |
|---|---|
| SDH | Synchronous Digital Hierarchy |
| SOH | Section OverHead |
| STM-N | Synchronous Transport Module, level N |
| sub-STM-1 | medium capacity SDH radio transport module (51,840 Mbit/s AU-3 equivalent, also referred as STM-0 by ITU-T Recommendation G.861 [30]) |
| sub-sub-STM-1 | low capacity SDH radio transport module (n times VC-12 or VC2 equivalent) |
| TC | ETSI Technical Committee |
| TM | ETSI TC-Transmission and Multiplexing |
| TMN | Telecommunications Management Network |
| TV | TeleVision |
| VC-n | Virtual Container n |
| WG | Working Group |
| XPD | cross-Polar Discrimination |
| YS | defined by ITU-R Recommendation F.746 [4] as "the radio-frequency separation between the centre frequencies of the go and return radio-frequency channels which are nearest to each other". |

# 4 General characteristics

## 4.1 Frequency bands and channel arrangements

### 4.1.1 Channel arrangements

The equipment shall operate on one or more of the channels as defined below:

The frequency range shall be 37 GHz to 39,5 GHz. The channel arrangements shall be in accordance with CEPT T-TR 12-01 [1]. The channel plan is given in figure A.1.

The separation band shall be 140 MHz.

The innermost channels spacing (YS as defined by ITU-R Recommendation F.746 [4]) shall range from 143,5 MHz to 280 MHz for 3,5 MHz to 140 MHz channel spacing respectively.

The transmitter receiver duplex frequency separation shall be 1 260 MHz.

### 4.1.2 Co-polar channel spacing for systems operating, on different antennas, on the same route

System bit rates and their relevant co-polar channel spacing in the present document are reported in table 1 (for the precise payload bit rates, see subclause 5.1):

**Table 1: Digital systems channel spacings for various bit rates**

| | **Payload Bit Rate [Mbit/s] ⇒** | **2** | **2 × 2** | **8** | **2 × 8** | **34** | **51** | **140 and 155** |
|---|---|---|---|---|---|---|---|---|
| **Channel Spacings [MHz]** | Class 1 equipments | 7 | 7 | 14 | | 56 | | |
| | Class 2 equipments | 3,5 | 3,5 | 7 | 14 | 28 | 56 | 112 or 140 (note 2) |
| | Class 3 equipments | | | | | | 28 | 56 |

NOTE 1: n × 2 Mbit/s and n × 34 Mbit/s bit rates may be used where appropriate.
n × 2 Mbit/s mapped into SDH VC12 transport bit rates may be used where appropriate (e.g. three or four times VC12 into an 8 Mbit/s channel spacing).

NOTE 2: 112 MHz channel spacing may be used by Grade B equipments, however this channel spacing is not provided by CEPT Recommendation T/TR 12-01 [1].

Video base-band for analogue systems and their relevant co-polar channel spacing are reported in table 2.

**Table 2: Analogue systems channel spacings for various video base-band**

| **Video Base-band [MHz]** | < 3,5 | < 6 | < 10 | < 14 |
|---|---|---|---|---|
| **Channel Spacings [MHz]** | 28 | 56 | 56 | 56 |

## 4.2 Compatibility requirements between systems

The compatibility requirements between systems are as follows:

- there shall be no requirement to operate transmitting equipment from one manufacturer with receiving equipment from another;
- there shall not be a requirement to multiplex different manufacturers equipment on the same or on different polarization of the same antenna;
- depending on the application, it shall be possible to operate the system in vertical and/or horizontal polarization, if required by the channel arrangement.

## 4.3 Performance and availability requirements

Digital equipment shall be designed in order to meet network performance and availability requirements foreseen by ITU-T Recommendation G.826 [29], following the criteria defined in ITU-R Recommendations F.1189 [17] for the national portion of the digital connection.

The implication of the link design on the performance is recognized and the general design criteria reported in ITU-R Recommendations P.530-6 [19] and F.1102 [16] shall be applied.

## 4.4 Environmental conditions

The equipment shall be required to meet the environmental conditions set out in ETS 300 019 [6] which defines weather protected and non-weather protected locations, classes and test severity.

The manufacturer shall state which class the equipment is designed to withstand.

### 4.4.1 Equipment within weather protected locations (indoor locations)

Equipment intended for operation within temperature controlled locations or partially temperature controlled locations shall meet the requirements of ETS 300 019 [6] classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [6] classes 3.3 (non-temperature controlled locations), 3.4 (sites with heat trap) and 3.5 (sheltered locations) may be applied.

### 4.4.2 Equipment for non-weather protected locations (outdoor locations)

Equipment intended for operation within non-weather protected locations shall meet the requirements of ETS 300 019 [6], class 4.1 or 4.1E.

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

## 4.5 Power supply

The power supply interface shall be in accordance with the characteristics of one or more of the secondary voltages foreseen in ETS 300 132-1 [7] and ETS 300 132-2 [8].

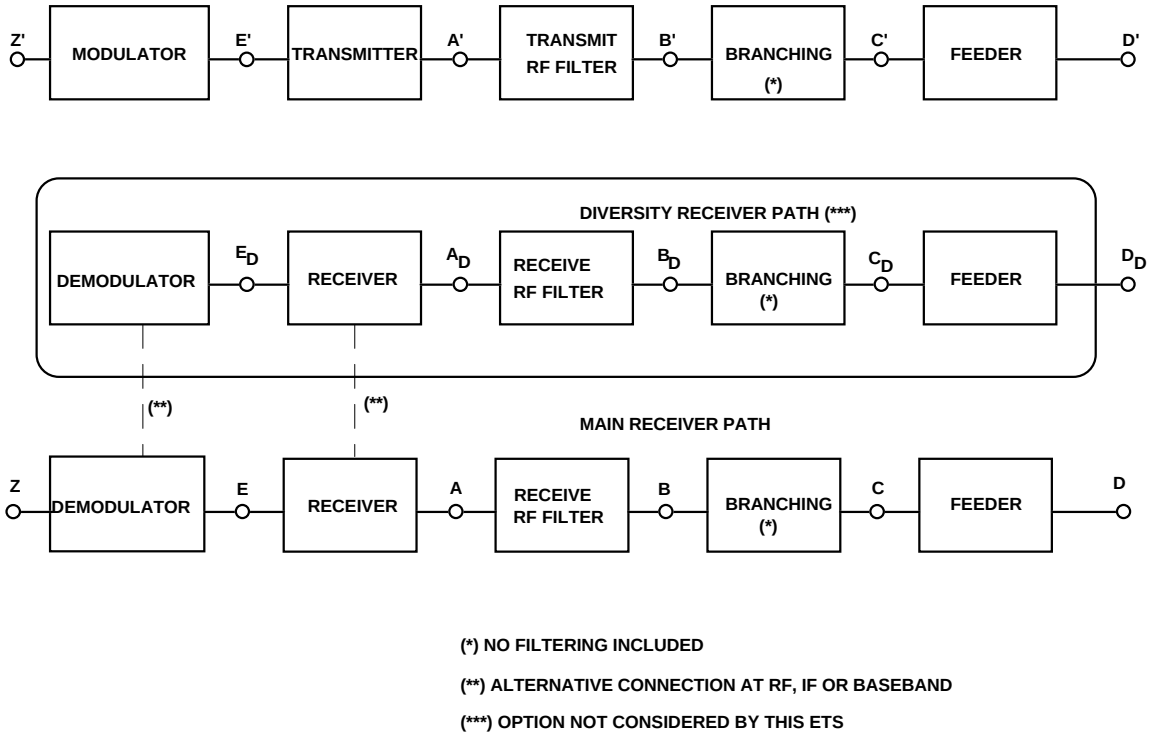
NOTE: Some applications may require secondary voltages that are not covered by ETS 300 132-1 [7] or ETS 300 132-2 [8].

## 4.6 Electromagnetic compatibility

Equipment with capacity of about 2 Mbit/s and above shall operate under the conditions specified in ETS 300 385 [11].

Analogue equipments shall operate under the conditions specified in ETS 300 339 [10]; performance criteria for immunity shall be specified by the supplier for the conformance test.

## 4.7 System block diagram




NOTE 1: For the purpose of defining the measurement points, the branching network does not include a hybrid.
NOTE 2: The points shown above are reference points only; points C and C', D and D' in general coincide.
NOTE 3: Points B and C, B' and C' may coincide when simple duplexer is used.

**Figure 1: System block diagram**

## 4.8 Telecommunications Management Network (TMN) interface

For SDH equipment ITU-T Recommendations G.784 [28] and G.773 [24] and ITU-R Recommendations F.750 [14] and F.751 [15] give the general requirements for TMN interface and functionality. ETS 300 635 [12], ETS 300 785 [13] and ETS 300 645 [5] give the radio specific functional block description and the related radio fragment information model respectively.

NOTE: The standardization of TMN interface functionalities is under study in ETSI WG TM2, and will be applicable to the radio relay systems considered in the present document.

## 4.9 Branching/feeder/antenna characteristics

### 4.9.1 Antenna radiation patterns

See subclause A.2.1.

### 4.9.2 Antenna cross-Polar Discrimination (XPD)

See subclause A.2.2.

### 4.9.3 Antenna Inter-Port Isolation (IPI)

See subclause A.2.3.

### 4.9.4 Waveguide flanges (or other connectors)

When flanges are required at reference point C, C', the following IEC type shall be used:

- UBR/PBR-320, for the complete frequency range.

### 4.9.5 Return loss

Equipments according to the present document are likely to have integral antennas or very similar technical solutions, without long feeder connections; return loss is not considered an essential requirement.

# 5 Parameters for digital systems

## 5.1 Transmission capacity

Payload bit rates considered in the present document are:

- 2,048 Mbit/s;
- 2 × 2,048 Mbit/s;
- 8,448 Mbit/s;
- 2 × 8,448 Mbit/s;
- 34,386 Mbit/s;
- 51,840 Mbit/s (sub-STM-1);
- 139,264 Mbit/s; and
- 155,520 Mbit/s (STM-1).

System rates configured as n-times 2 Mbit/s or n-times 34 Mbit/s or n-times 2 Mbit/s mapped into SDH VC-12 (sub-sub-STM-1) are also considered.

In the following clauses, these capacities will be simply referred as 2 Mbit/s, 2 × 2 Mbit/s, 8 Mbit/s, 2 × 8 Mbit/s, 34 Mbit/s, 51 Mbit/s(sub-STM-1), 140 Mbit/s, and 155 Mbit/s (STM-1) respectively.

## 5.2 Baseband parameters

### 5.2.1 Plesiochronous interfaces

Plesiochronous interfaces at 2 Mbit/s, 8 Mbit/s, 34 Mbit/s and 140 Mbit/s shall comply with ITU-T Recommendation G.703 [21]. Parameters for service channels and wayside traffic channels are outside the scope of the present document.

### 5.2.2 ISDN interface (primary rate)

The transmission of 2 Mbit/s signals using the structure and functions of ISDN primary multiplex signals shall be in accordance with ITU-T Recommendations G.703 [21], G.704 [22] and I.412 [32] and ETS 300 233 [9].

### 5.2.3 SDH baseband interface

The SDH baseband interface shall be in accordance with ITU-T Recommendations G.703 [21], G.707 [23], G.781 [25], G.782 [26], G.783 [27], G.784 [28] and G.957 [31] (with possible simplifications under study in ETSI WG TM3 and WG TM4) and ITU-R Recommendations F.750 [14] and F.751 [15].
For sub-sub-STM-1 ITU-T Recommendation G.861 [30] mapping applies.

Two STM-1 interfaces shall be possible:

- Coded Mark Inversion (CMI) electrical (ITU-T Recommendation G.703 [21]); and
- Optical (ITU-T Recommendation G.957 [31]).

The use of reserved bytes contained in the Section Overhead (SOH), and their termination shall be in accordance with ITU-R Recommendations F.750 [14], F.751 [15] and for sub-sub-STM-1with ITU-T Recommendation G.861 [30].

NOTE: Further details on the possible use of the SOH bytes reserved for future international standardization are given in annex 1 of TR 101 035 V1.1.2.

## 5.3 Transmitter characteristics

The specified transmitter characteristics shall be met with the appropriate baseband signals applied at reference point Z' of figure 1. For PDH interface this shall be a Pseudo Random Binary Sequence (PRBS) according ITU-T Recommendation O.151 [33] while for SDH interface ITU-T Recommendation O.181 [34] test signal apply.

### 5.3.1 Transmitter power range

According to CEPT Recommendation T/R 12-01 [1] maximum Equivalent Isotropically Radiated Power (EIRP) shall be less than +80 dBm. Transmitter maximum mean output power at reference point C' of the system block diagram (Figure 1) shall not exceed +30 dBm (including tolerance and, if applicable, ATPC/RTPC influence).

Regulatory administrations may define nominal sub-ranges below this maximum limit.

NOTE: The technological evolution may result in equipment falling outside of the range(s) foreseen in this clause. In this case the equipments of different output power sub-ranges are not considered to require individual type approval, however their use is subject to individual national agreements.

A capability for output power level adjustment may be required for regulatory purposes, in which case the range of adjustment, either by fixed or automatic attenuators, should be in increments of 5 dB or less.

### 5.3.2 Transmit power and frequency control

#### 5.3.2.1 Automatic Transmit Power Control (ATPC)

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

- ATPC set manually to a fixed value for system performance (subclauses 5.5 and 5.6);
- ATPC set at maximum nominal power for transmit performance (subclause 5.3).

#### 5.3.2.2 Remote Transmit Power Control (RTPC)

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

- RTPC set to the maximum nominal power for transmit performance (subclause 5.3) and for system performance (subclauses 5.5 and 5.6);
- the RF spectrum mask shall be verified in three points (low, medium, high) of the RTPC power excursion. When these spectrum measurement are concerned, the lower floor of the spectrum mask, will not be measured if it will become lower than an absolute level of -50 dBm within the recommended resolution bandwidth.

#### 5.3.2.3 Remote Frequency Control (RFC)

RFC is an optional feature. Equipment with RFC will be subject to manufacturer declaration of RFC ranges and related change frequency procedure. Testing shall be carried out including:

- RFC setting procedure at least for three frequencies (lower, centre and higher of the covered range);
- RFC setting procedure shall not produce emissions outside the previous and final frequency spectrum mask.

### 5.3.3 Transmitter output power tolerance

The nominal output power shall be declared by the supplier.

The tolerance of the nominal output power shall be within:

- for systems operating within non-weather protected locations and within classes 3.3 , 3.4 and 3.5 weather protected locations:
  - nominal output power ±3 dB.
  - for systems operating within other classes of weather protected locations:
  - nominal output power ±2 dB.

### 5.3.4 Transmit Local Oscillator (LO) frequency arrangements

There shall be no requirement on LO frequency arrangement.

### 5.3.5 RF spectrum mask

The spectrum masks are shown in figure 2.

The 0 dB level shown on the spectrum masks relates to the spectral power density of the nominal centre frequency disregarding residual carrier.

Masks shall be measured with a modulating base-band signal given by a PRBS signal given in ITU-T Recommendation O.151 [33] in the case of PDH signal or ITU-T Recommendation O.181 [34] in the case of STM-1 signal.

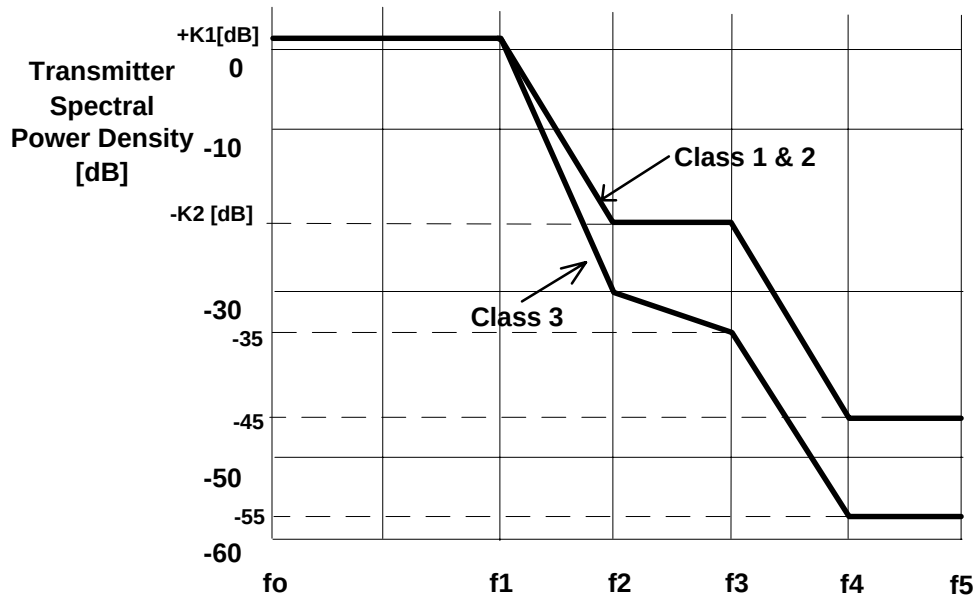
The masks for grade A systems include an allowance of ±50 ppm. for frequency tolerance (see note) while for grade B systems do not include frequency tolerance.

NOTE: Including both short term (environmental) and long term (ageing) tolerance; the latter subject to supplier declaration.

The recommended spectrum analyser settings for measuring the RF spectrum mask detailed in figure 2 are shown in the table 3.

**Table 3: Spectrum analyser settings for RF power spectrum measurement**

| Channel Spacing [MHz] | | 3,5 | 7 | 14 | 28 | 56 | 112 or 140 |
|---|---|---|---|---|---|---|---|
| Centre Frequency | Grade B | Actual | Actual | Actual | Actual | Actual | Actual |
| | Grade A | Nominal | Nominal | Nominal | Nominal | Nominal | Nominal |
| Sweep width [MHz] | | 20 | 40 | 80 | 160 | 320 | 640 or 800 |
| Scan time | | Auto | Auto | Auto | Auto | Auto | Auto |
| IF bandwidth [kHz] | | 30 | 30 | 30 | 100 | 100 | 100 |
| Video bandwidth [kHz] | | 0,1 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 |




Frequency from nominal transmitter centre frequency [MHz] Grade A systems.
Frequency from actual transmitter centre frequency [MHz] Grade B systems.

**Figure 2: Limits of spectral power density**

Reference frequencies f 1 to f 5 and relative attenuation K1[dB] and K2[dB] are reported in table 4 for the bit rate and channel spacing foreseen:

**Table 4: Spectrum mask frequency limits**

| Spectrum efficiency class | Bit-rate [Mbit/s] | Channel spacing [MHz] | System grade | K1 [dB] | K2 [dB] | f 1 [MHz] | f 2 [MHz] | f 3 [MHz] | f 4 [MHz] | f 5 [MHz] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 7 | A | 0 | -25 | 3,3 | 6,1 | 6,8 | 12,8 | 17,5 |
| | 8 | 14 | A | 0 | -25 | 6 | 11,6 | 13 | 22 | 35 |
| | 34 | 56 | A | 0 | -25 | 24 | 50 | 60 | 80 | 140 |
| 2 | 2 or 2 × 2 | 3,5 | A | 0 | -25 | 1,65 | 3,05 | 3,4 | 6,4 | 8,75 |
| | 8 | 7 | A | 0 | -25 | 3,3 | 6,1 | 6,8 | 12,8 | 17,5 |
| | 34 | 28 | A | 0 | -20 | 11 | 18 | 25 | 50 | 70 |
| | 140 or155 | 140 | A | 0 | -25 | 46 | 84 | 105 | 164 | 350 |
| | 2 | 3,5 | B | +1 | -23 | 1,3 | 2 | 2,3 | 4,3 | 8,75 |
| | 2 × 2 | 3,5 | B | +1 | -23 | 1,4 | 2,8 | 3,5 | 7 | 8,75 |
| | 8 | 7 | B | +1 | -23 | 2,8 | 5,6 | 7 | 14 | 17,5 |
| | 2 × 8 | 14 | B | +1 | -23 | 5,6 | 11,2 | 14 | 28 | 35 |
| | 34 | 28 | B | +1 | -23 | 11 | 19 | 25 | 45 | 70 |
| | 51 | 56 | B | +1 | -23 | 18 | 32 | 40 | 70 | 140 |
| | 140 or155 | 112 or 140 | B | +1 | -23 | 45 | 78 | 105 | 125 | 280 |
| 3 | 51 | 28 | B | +1 | n.a. | 10,5 | 18 | 28 | 35,5 | 70 |
| | 140 or 155 | 56 | B | +1 | n.a. | 22,5 | 33 | 65 | 80 | 140 |
| NOTE: n. a. = not applicable. | | | | | | | | | | |

## 5.3.6 Spectral lines at the symbol rate

The power level (reference point B') of spectral lines at a distance from the channel centre frequency equal to the symbol rate shall be more than 23 dB below the average power level of the carrier.

## 5.3.7 Spurious emissions

It is necessary to define spurious emissions from transmitters for two reasons:

a) to limit interference into systems operating wholly externally to the system (external emissions);

b) to limit local interference within the system where transmitters and receivers are directly connected via the filter and branching systems (internal emissions).

This leads to two sets of spurious emission limits where the specific limits given for "internal" interference are required to be no greater than the "external" level limits at reference point C'.

### 5.3.7.1 Spurious emissions - external

According to ITU-R Recommendation SM.329-6 [20] and the application to fixed service provided by ITU-R Recommendation F.1191 [18] the external spurious emissions are defined as emissions at frequencies which are ±250 % of the relevant channel spacing outside the nominal carrier frequency.

The frequency range in which the spurious emission specifications apply is 9 kHz to 110 GHz (see note), however for conformance test measurement may be limited to the second harmonic frequency.

NOTE: When a waveguide is used between reference points A' and C', which has a length greater than twice the free space wavelength of cut-off frequency (Fc), the lower limit of measurement will be increased to 0,7 Fc and to 0,9 Fc when the length is greater than four times the same wavelength.

For "noise-like" emissions, the limits are not intended to be exceeded in any elementary measuring bandwidth.

The limit values measured at reference point C' are shown in subclauses 5.3.7.1.1 and 5.3.7.1.2.

#### 5.3.7.1.1 Within the relevant channel spacing

When within ±250 % of the relevant channel spacing, the emission which includes in this range fundamental and out of band emissions only and shall be in accordance with the spectrum mask and the limits required by subclauses 5.3.5 and 5.3.6.

#### 5.3.7.1.2 Outside the band of the relevant channel spacing

When outside the band of ±250 % of the relevant channel spacing:

- emissions falling from 9 kHz to 21,2 GHz:
  - -50 dBm in any 1 kHz band (from 9 kHz to 150 kHz);
  - -50 dBm in any 10 kHz band (from 150 kHz to 30 MHz);
  - -50 dBm in any 100 kHz band (from 30 MHz to 1 GHz);
  - -50 dBm in any 1 MHz band (from 1 GHz to 21,2 GHz).
- emissions falling from 21,2 GHz to 110 GHz:
  - -30 dBm in any 100 kHz band (for channel spacings ≤ 7 MHz and in the range from ±250% of channel spacing to ±56 MHz);
  - -30 dBm in any 1 MHz band (all other cases).

For the purpose of the spectrum analyser measurement, the start (or the stop) frequency at the exclusion bandwidth edges shall be higher (or lower) than the edges frequency by an amount equal to evaluation Bandwidth divided by 2 (BWe/2).

### 5.3.7.2 Spurious emissions - internal

Given that there is no requirement to multiplex equipment of different supplier on the same antenna, there is no requirement for internal spurious emissions.

## 5.3.8 Radio frequency tolerance

Maximum radio frequency tolerance shall not exceed ±50 ppm for grade A systems and ±15 ppm for grade B systems. This limit includes both short-term factors (environmental effects) and long-term ageing effects.

In the type test the manufacturer shall state the guaranteed short-term part and the expected ageing part.

# 5.4 Receiver characteristics

## 5.4.1 Input level range

The input level range for a BER $<10^{-3}$ shall extend for a minimum of 50 dB above the threshold limit specified for BER = $10^{-3}$ in subclause 5.5.1 referenced to point C. However, for grade A systems, an upper limit above -30 dBm is not required.

When ATPC is used on a permanent basis the input level range, defined as above, may be reduced to 40 dB.

## 5.4.2 Receiver local oscillator frequency arrangements

There shall be no requirement on LO frequency arrangement.

### 5.4.3 Spurious emissions

The frequency range in which the spurious emission specifications apply is 9 kHz to 110 GHz (see note), however for conformance test measurement will be limited to the second harmonic frequency.

NOTE: When a waveguide is used between reference point A' and C', which has a length greater than twice the free space wavelength of cut-off frequency (Fc), the lower limit of measurement will be increased to 0,7 Fc and to 0,9 Fc when the length is greater than four times the same wavelength.

#### 5.4.3.1 Spurious emissions - external

Spurious emissions shall not exceed the following levels at reference point C:

- emissions falling from 9 kHz to 21,2 GHz:
  - -50 dBm in any 1 kHz band (from 9 kHz to 150 kHz);
  - -50 dBm in any 10 kHz band (from 150 kHz to 30 MHz);
  - -50 dBm in any 100 kHz band (from 30 MHz to 1 GHz);
  - -50 dBm in any 1 MHz band (from 1GHz to 21,2 GHz);
- emissions falling from 21,2 GHz to 110 GHz:
  - -30 dBm in any 1 MHz band.

#### 5.4.3.2 Spurious emissions - internal

Given that there is no requirement to multiplex equipment of different supplier on the same antenna, there is no requirement for internal spurious emissions.

## 5.5 System performance without diversity

All parameters are referred to reference point C of figure 1. Losses in RF couplers used for protected systems are not taken into account in the limits specified below.

All measurements shall be carried out with the test signals defined in subclause 5.3.

### 5.5.1 BER as a function of Receiver input Signal Level (RSL)

Receiver BER thresholds (dBm) referred to reference point C of the system block diagram (see figure 1) for a BER of $10^{-3}$, $10^{-6}$ and $10^{-8}$ shall be equal to or lower than those stated in table 5:

**Table 5: BER performance thresholds**

| | | | RSL @ BER → | RSL @ $10^{-3}$ [dBm] | RSL @ $10^{-6}$ [dBm] | RSL @ $10^{-8}$ [dBm] |
|---|---|---|---|---|---|---|
| Spectrum efficiency class ↓ | Bit-rate [Mbit/s] ↓ | Channel spacing [MHz] ↓ | System grade ↓ | | | |
| 1 | 2 | 7 | A | -81 | -78 | -74 |
| | 8 | 14 | A | -75 | -72 | -68 |
| | 34 | 56 | A | -72 | -69 | -65 |
| 2 | 2 × 2 | 3,5 | A | -82 | -77 | -73 |
| | 8 | 7 | A | -80 | -75 | -71 |
| | 34 | 28 | A | -72 | -69 | -65 |
| | 140 or 155 | 140 | A | -66 | -63 | -59 |
| | 2 | 3,5 | B | -86 | -82,5 | -80 |
| | 2 × 2 | 3,5 | B | -83 | -79,5 | -77 |
| | 8 | 7 | B | -80 | -76,5 | -74 |
| | 2 × 8 | 14 | B | -77 | -73,5 | -71 |
| | 34 | 28 | B | -74 | -70,5 | -68 |
| | 51 | 56 | B | -73 | -69,5 | -67 |
| | 140 or 155 | 112 or 140 | B | -68 | -64,5 | -62 |
| 3 | 51 | 28 | B | -71 | -67,5 | -65 |
| | 140 or 155 | 56 | B | -66 | -62,5 | -60 |

## 5.5.2 Equipment background BER

The equipment Background BER (BBER) level under simulated operating conditions without interference is measured with a signal level at reference point C which is 10 dB above the level which gives BER = $10^{-6}$ (as specified in subclause 5.5.1).

- For systems capacity less than 34 Mbit/s: BBER < $10^{-10;}$
- for systems capacity above 34 Mbit/s: BBER < $10^{-11;}$
- all measurements are made at the payload bit rate defined in subclause 5.1 (see note).

NOTE: Equipment which may supply different payload bit rates on the same aggregate transport rate are not required to perform individual BBER type approval for every possible payload port, the manufacturer will present one for type approval and make conformance declaration for the others.

Table 6 gives the minimum recording time and the maximum numbers of errors that shall not be exceeded:

**Table 6: Allowed number of errors in a 24 hours background BER test**

| Bit-rate under test [Mbit/s] | Minimum recording time [hours] | Maximum errors number |
|---|---|---|
| 2 | 24 | 17 |
| 8 | 16 | 38 |
| 34 | 24 | 27 |
| 51 | 16 | 27 |
| 140/STM-1 | 8 | 36/41 |

## 5.5.3 Interference sensitivity

All receive signal levels and Carrier to Interference ratio(C/I) measurements are referred to reference point C of the RF system block diagram (see figure 1).

### 5.5.3.1 Co-channel interference sensitivity

The limits of Co-channel Interference (C/I) shall be as in table 7, giving maximum C/I values for 1 dB and 3 dB degradation of the $10^{-6}$ BER limits specified in subclause 5.5.1.

For frequency co-ordination purpose intermediate values may be found in figure A.4.1.

**Table 7: Co-channel interference sensitivity**

| co-channel interference | | RSL @ BER → | | RSL @ $10^{-6}$ | |
|---|---|---|---|---|---|
| | | degradation → | | 1 dB (note 1) | 3 dB |
| Spectrum efficiency class ↓ | Bit rate [Mbit/s] ↓ | Channel spacing [MHz] ↓ | System grade ↓ | | |
| 1 | 2 | 7 | A | 23 | |
| | 8 | 14 | A | 23 | |
| | 34 | 56 | A | 23 | |
| 2 | 2 × 2 | 3,5 | A | 23 | |
| | 8 | 7 | A | 23 | |
| | 34 | 28 | A | 23 | |
| | 140 or 155 | 140 | A | 23 | |
| | 2 | 3,5 | B | 23 | 19 |
| | 2 × 2 | 3,5 | B | 23 | 19 |
| | 8 | 7 | B | 23 | 19 |
| | 2 × 8 | 14 | B | 23 | 19 |
| | 34 | 28 | B | 23 | 19 |
| | 51 | 56 | B | 23 | 19 |
| | 140 or 155 | 112 or 140 | B | 23 | 19 |
| 3 | 51 | 28 | B | 30 | 26 |
| | 140 or 155 | 56 | B | 30 | 26 |

NOTE 1: For grade A systems the 1 dB degradation of $10^{-6}$ BER threshold is considered equivalent to the BER degradation from $10^{-6}$ to $10^{-5}$, formerly required by the previous edition of the present document.

### 5.5.3.2 Adjacent channel interference

The limits of adjacent channel interference shall be as given in table 8 for like modulated signals spaced of 1 channel spacing, giving maximum C/I values for 1 dB and 3 dB degradation of the $10^{-6}$ BER limits specified in subclause 5.5.1.

For frequency co-ordination purpose intermediate values may be found in figure A.4.2.

**Table 8: First adjacent channel interference sensitivity**

| First adjacent channel interference | | RSL @ BER → | | RSL @ $10^{-6}$ | |
|---|---|---|---|---|---|
| | | degradation → | | 1 dB (note 1) | 3 dB |
| Spectrum efficiency class ↓ | Bit rate [Mbit/s] ↓ | Channel spacing [MHz] ↓ | System grade ↓ | | |
| 1 | 2 | 7 | A | 0 | |
| | 8 | 14 | A | 0 | |
| | 34 | 56 | A | 0 | |
| 2 | 2 × 2 | 3,5 | A | 0 | |
| | 8 | 7 | A | 0 | |
| | 34 | 28 | A | 0 | |
| | 140 or 155 | 140 | A | 0 | |
| | 2 | 3,5 | B | -3 | -7 |
| | 2 × 2 | 3,5 | B | 0 | -4 |
| | 8 | 7 | B | 0 | -4 |
| | 2 × 8 | 14 | B | 0 | -4 |
| | 34 | 28 | B | 0 | -4 |
| | 51 | 56 | B | 0 | -4 |
| | 140 or 155 | 112 or 140 | B | 0 | -4 |
| 3 | 51 | 28 | B | -1 | -5 |
| | 140 or 155 | 56 | B | -1 | -5 |

NOTE 1: For Grade A systems the 1 dB degradation of $10^{-6}$ BER threshold is considered equivalent to the BER degradation from $10^{-6}$ to $10^{-5}$, formerly required by the previous edition of the present document. For all grades and categories 1 and 2, regulatory administrations may wish to vary the value of C/I for 1 dB degradation for adjacent channel interference. Values of C/I are typically in the range 0 dB to -3 dB.

#### 5.5.3.3 Continuous Wave (CW) spurious interference

The CW spurious response rejection ratio of a receiver is a measure of its ability to discriminate between the wanted signal at the nominal channel frequency of the receiver and an unwanted signal at any other frequency at which a response is obtained.

For a receiver operating at the RSL specified in subclause 5.5.1. for $10^{-6}$ BER threshold, the introduction of a CW interferer at a level of +30 dB, with respect to the wanted signal shall not result in a BER greater than $10^{-5}$.

The requirement shall be matched at any frequency in the range 9 kHz to 110 GHz, excluding frequencies either side of the wanted frequency by up to twice the foreseen co-polar channel spacing. When a DRRS uses a waveguide to connect the receiver to the antenna, the lower limit of measurement shall be increased up to the limit shown in TR 101 036-01 V1.1.2 [35].

The test is not intended to imply a relaxed specification at all out of band frequencies elsewhere specified in the present document.

#### 5.5.3.4 Front-end non-linearity requirements (two-tone CW spurious interference)

This performance is required for grade B systems only.

For a receiver operating at the RSL specified in subclause 5.5.1 for $10^{-6}$ BER threshold, the introduction of two equal CW interferes each with a level of +19 dB, with respect to the wanted signal and located at the second and fourth adjacent channel in the receive half-band, shall not result in a BER greater than $10^{-5}$.

### 5.5.4 Distortion sensitivity

Outage from multi-path phenomena is not considered relevant for the systems subject to the present document.

## 5.6 System characteristics with diversity

Space diversity receive is not relevant for the systems subject to the present document.

# 6 Parameters for wideband analogue systems

## 6.1 Transmit/receive capacity

The following video baseband bandwidths may be used:

a) up to 3,5 MHz;

b) up to 6 MHz;

c) up to 10 MHz;

d) up to 14 MHz.

These may have sub-carriers associated with them.

It is recognized that sub-carriers shall be used to carry four distinct traffic types:

- CW (e.g. continuity pilot);
- low frequency analogue (e.g. audio);
- wide band analogue (e.g. secondary video);
- data (e.g. 2 Mbit/s).

## 6.2 Applications

Point-to-point TV (broadcast quality).

Point-to-point TV (surveillance).

Point-to-point wide band video (radar remoting).

## 6.3 Baseband parameters

### 6.3.1 Video interfaces

| | |
|---|---|
| Level: | nominally 1 V peak-to-peak. |
| Impedance: | 75 Ω unbalanced. |
| Minimum return loss: | 26 dB. |

### 6.3.2 Audio interfaces (if applicable)

| | |
|---|---|
| Level: | 0 dBu to 6 dBu (peak level +9 dBm to +15 dBm). |
| Impedance: | input 600 Ω symmetric;<br>output < 50 Ω symmetric. |
| Minimum return loss: | 20 dB. |

### 6.3.3 Digital interfaces (if applicable)

For ITU bit rates the interface should conform to ITU Recommendation G.703 [21].

### 6.3.4 IF interfaces (if applicable)

Characteristics should be in accordance with ITU-R Recommendation F.403 [36].

### 6.3.5 Baseband performance

In view of varied and numerous potential applications for analogue links it is not practicable to specify the overall performance characteristics for individual applications.

As an example, some sample performance parameters are given in table 9 applicable to an analogue hop carrying a Phase Alternate Line (PAL) video signal together with an audio channel.

**Table 9: Example of some performance parameters for a video and an audio channel**

| **Video** | |
|---|---|
| Signal to noise - continuous weighted | 60 dB |
| Noise - periodic | -60 dB |
| Baseband frequency response | ±1 dB |
| Baseband group delay | 20 ns |
| Differential phase | ±2° |
| Differential gain | ±2 % |
| Linear wave form distortion | 2 % |
| **Audio** | |
| Frequency response | ±1 dB |
| Total harmonic distortion | 0,5% |
| Noise - weighted | 60 dBq0ps |

NOTE: All measurements made at 40 dB above receive threshold as defined in subclause 6.6.1.

The absolute performance characteristics for broadcast quality video and audio channels are available in the relevant ITU-R (CMTT) or ITU-T Recommendations.

## 6.4 Transmitter characteristics

### 6.4.1 Transmitter power range

Maximum output power up to 1 W referred to point C' of the system block diagram (see figure 1).

### 6.4.2 Transmitter output power tolerance

The output power tolerance shall be within:

±4 dB: classes 3.3 to 3.5 (as defined in subclause 4.4.1) and all classes as defined in subclause 4.4.2.

±3 dB: classes 3.1 and 3.2 (as defined in subclause 4.4.1).

## 6.4.3 Radiated spectrum

### 6.4.3.1 Spectrum mask

The equipment shall comply with the appropriate RF power spectrum mask from those given in figures 3 and 4. The 0 dB reference level shown on the spectrum masks shall be set to the level of the unmodulated carrier. All spectrum masks include an allowance for frequency stability.

Spectrum analyser settings for RF power spectrum measurements should be those given in table 10.

**Table 10: Spectrum analyser settings for RF power spectrum measurements**

| Video baseband bandwidth (MHz) | < 3,5 MHz | < 14 MHz |
|---|---|---|
| IF bandwidth (kHz) | 30 | 30 |
| Total sweep width (MHz) | 100 | 100 |
| Video filter bandwidth (kHz) | 0,3 | 0,3 |
| Recommended scan time (s) | 50 | 50 |

### 6.4.3.2 Frequency deviation

See table 9.

**a) Primary video:**

the primary video may be defined as that traffic not carried on a sub-carrier. No limit applies to the frequency deviation of the primary traffic.

**b) Sub-carrier deviation of the main carrier:**

The maximum sub-carrier deviation for each type of traffic is given in table 11 and these limits should apply both when the sub-carrier is modulated or unmodulated.

**Table 11: Transmitter characteristics:**
**Maximum frequency deviations of the main carrier by sub-carriers**

| **Video baseband** | < 3,5 MHz | < 6 MHz | < 10 MHz | < 14 MHz |
|---|---|---|---|---|
| **Channel spacing** | 28 MHz | 56 MHz | 56 MHz | 56 MHz |
| **Maximum frequency deviation of the main carrier** | | | | |
| **Primary video** | No limit | No limit | No limit | No limit |
| **Sub-carriers** | | | | |
| **-CW (pilot)** | 0,6 MHz | 1 MHz | 1 MHz | - |
| **-Narrow band analogue (audio)** | 0,6 MHz | 2 MHz | 2 MHz | - |
| **-Wide band analogue (video)** | - | 4 MHz | 4 MHz | - |
| **-Digital** | - | 2 MHz | 2 MHz | - |
| **Spectrum mask** | figure 3 | figure 4 | figure 4 | figure 4 |

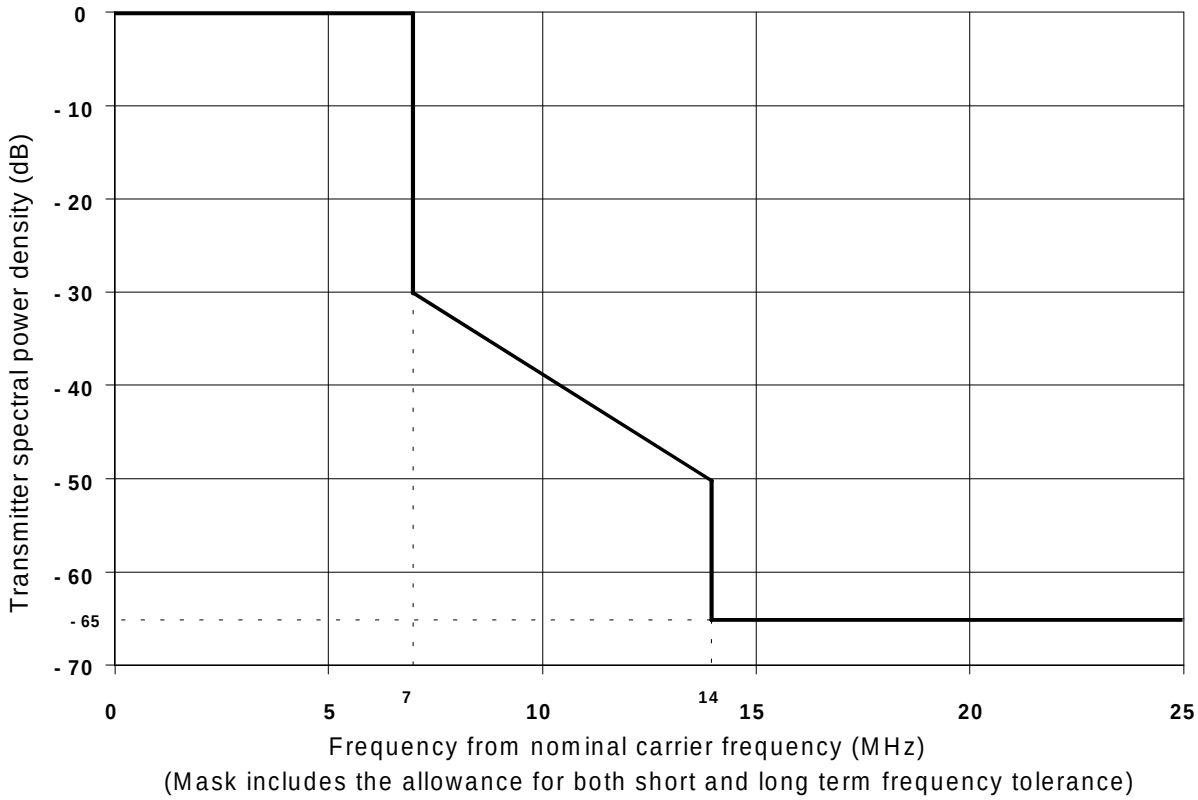



**Figure 3: Limits of spectral power density for video basebands up to 3,5 MHz using channel spacing of 28 MHz (referred to nominal centre frequency (fo))**

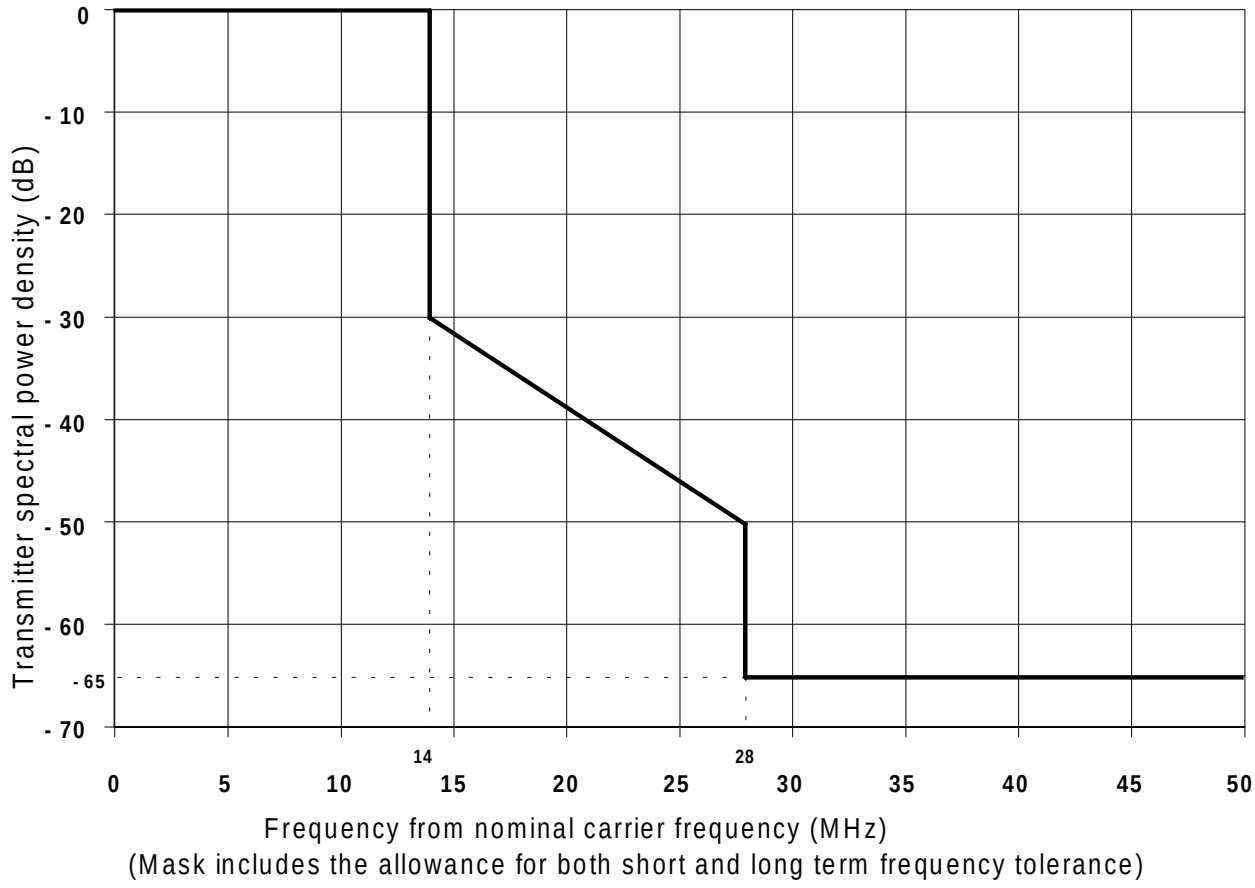



**Figure 4: Limits of spectral power density for video basebands up to 14 MHz using channel spacing of 56 MHz (referred to nominal centre frequency (fo))**

### 6.4.4 Spurious emissions

The transmitter shall be unmodulated, and the level of each spurious emission in the frequency range 30 MHz to 80 GHz, shall not exceed:

30 MHz to 21,2 GHz: -90 dBW;

21,2 GHz to 80 GHz : -60 dBW.

NOTE 1: All levels should be measured at point C'.

NOTE 2: Spurious emissions are emissions at frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, inter-modulation products and frequency conversion products, but exclude emissions which result from the modulation process.

NOTE 3: Definitions and methods of measurement for integrated equipment where the antenna port is not accessible are under study.

The lower frequency limit for spurious emissions conformance testing and receiver spurious response rejection shall be half the waveguide cut-off frequency subject to the input/output waveguide being not less than two cut-off wavelengths long.

### 6.4.5 Radio frequency tolerance

Radio frequency tolerances are included in the spectrum masks (see figures 3 and 4). The maximum allowable RF frequency tolerance shall not exceed ±100 ppm.

## 6.5 Receiver characteristics

All measurements refer to point C of the system block diagram (see figure 1).

### 6.5.1 Input level range

From -50 dBW to receiver threshold, as defined in subclause 6.6.1.

### 6.5.2 Spurious emissions

The frequency range in which the spurious emissions specifications apply shall be 30 MHz to 80 GHz. The limit values measured at point C are:

- 30 MHz to 21,2 GHz: -90 dBW;
- 21,2 GHz to 80 GHz : -60 dBW.

NOTE: Definitions and methods of measurement for integrated equipment where the antenna port is not accessible are under study.

The lower frequency limit for spurious emissions conformance testing and receiver spurious response rejection shall be half the waveguide cut-off frequency subject to the input/output waveguide being not less than two cut-off wavelengths long.

### 6.5.3 Noise figure

The receiver noise figure shall not exceed 12 dB.

# 6.6 System performance

## 6.6.1 Receiver threshold

The receiver threshold is defined as the receive signal level, referred to as point C of the system diagram, as shown in figure 1, at which a certain minimum performance is reached. In view of the wide variety of equipment types to be found in practice, it is not proposed to state limits for this parameter. However, in order to specify meaningful interference limits, it is necessary to use the measured receiver threshold as a baseline.

The signal/unweighted noise ratio shall be measured at each output port (video, audio, etc.) as a function of receive signal level. The receiver threshold shall be defined as the receive level at which the relationship between the receive signal level and the output signal/noise ratio deviates by 3 dB from the linear 1dB/dB interpolated behaviour. It is recognized that for a composite video signal (incorporating modulated sub-carriers) the threshold will be different for each output signal; the receiver threshold in this case should be taken as the highest receive signal level at which any of the output signals reaches the receiver threshold.

## 6.6.2 Interference sensitivity

**a) Co-channel interference:**

For planning purposes it should be assumed that the level of co-channel interference into the wide band analogue channel should not exceed -125 dBW. It should be recognized that the degradation in performance caused by this interference shall depend on a number of equipment characteristics (e.g. deviation, receiver noise performance, etc.) and it is, therefore, not proposed to set limits on this parameter. However, it is desirable to measure and record the co-channel interference level.

**b) Adjacent channel interference:**

For a receiver operating with a wanted signal whose level is 9 dB above the receiver threshold measured in subclause 6.6.1, the introduction at point C of a like modulated interferer at the level and frequency separation given in table 12 should not result in a degradation of the output signal/noise ratio of more than 1 dB.

**Table 12: Adjacent channel separation and interference levels**

| | Separation of wanted and interfering signal (MHz) | | Interference level (carrier/interference (dB)) | |
|---|---|---|---|---|
| **Video baseband** | **Co-polar** | **Cross polar** | **Co-polar** | **Cross polar** |
| < 3,5 MHz | 28 | N/A | 0 | N/A |
| < 6 MHz | 56 | N/A | 0 | N/A |
| < 10 MHz | 56 | N/A | 0 | N/A |
| < 14 MHz | 56 | N/A | 0 | N/A |

**c) CW spurious interference:**

For a receiver operating with a wanted signal whose level is 9 dB above the receiver threshold measured in subclause 6.6.1, the introduction at point C of a CW interferer at a level of +30 dB with respect to the wanted signal and at any frequency from 30 MHz to 80 GHz, excluding frequencies either side of the wanted signal by up to twice the relevant co-polar spacing, shall not result in a degradation of any output signal/noise ratio of more than 1 dB.

# Annex A (informative): Additional information

## A.1 Radio frequency channel arrangement

The relevant radio frequency channel arrangement is provided by CEPT T/TR 12-01 [1]; however, for readers convenience, figure A.1 gives its general overview:

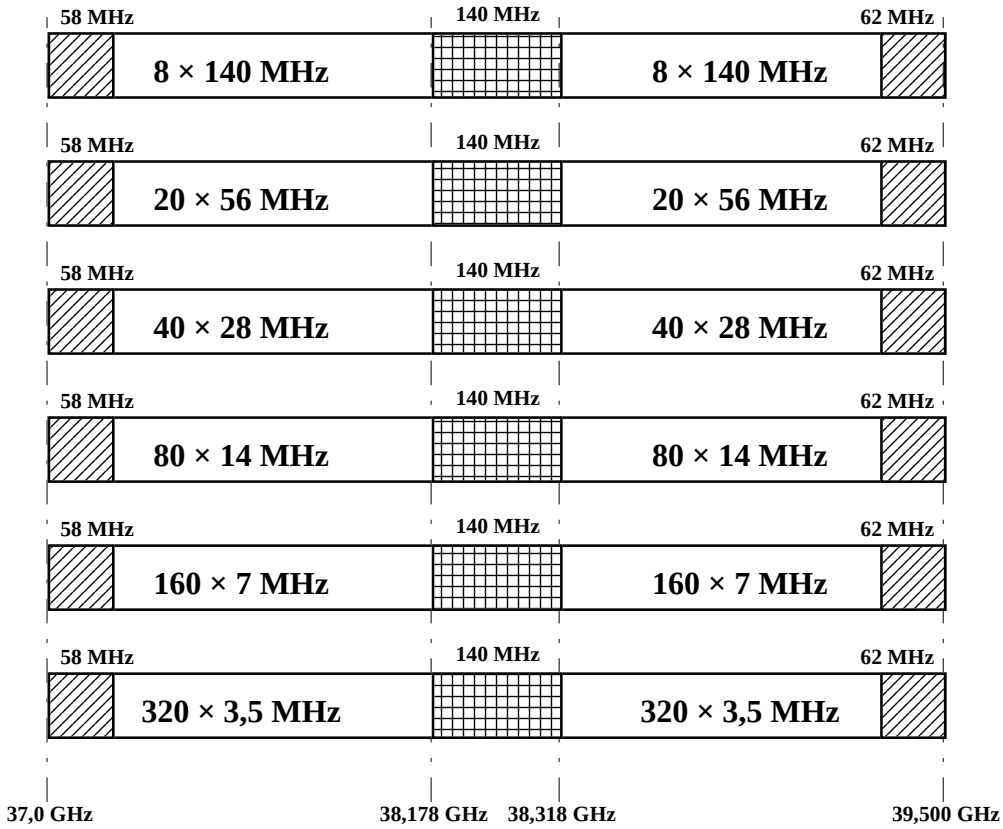



**Figure A.1: Radio frequency channel arrangement**

## A.2 Antenna characteristics

WG TM4 has started standardizing antennas radiation patterns and integral antennas (see ETS 300 833 [3]).

### A.2.1 Antenna radiation patterns

- For grade B equipment, either with separated or integral antenna, the radiation pattern should be in accordance with ETS 300 833 [3].

- For grade A equipment on which the antenna forms an integral part, the antenna radiation pattern may be either in accordance with ETS 300 833 [3].or within the envelope given in the masks 2A, 2B and 2C of figure A.2. for type A, B and C increasing directivity performance antennas respectively. The selection of antenna type may be made according interference requirements and local licensing.

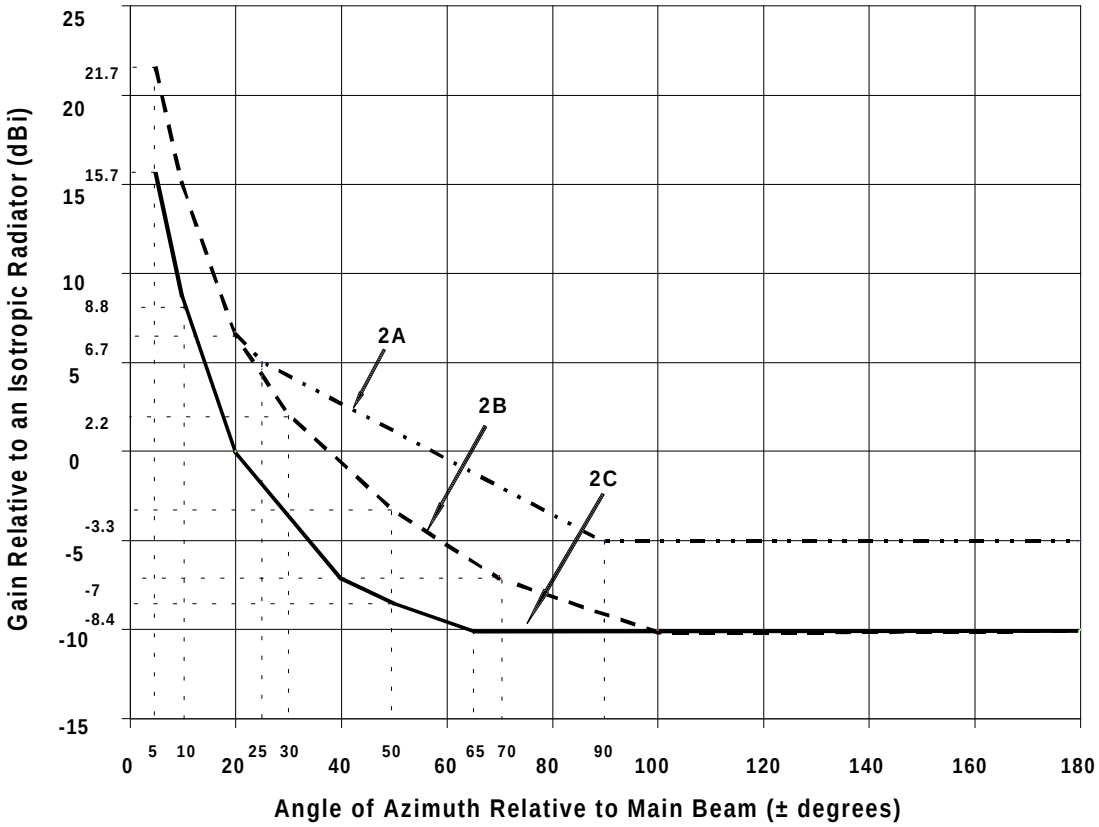



**Figure A.2: Limits of antenna gain for angles greater than 5° from the main beam axis (under test conditions)**

## A.2.2 Antenna cross-Polar Discrimination (XPD)

For equipment, either with separated or integral antenna, the antenna XPD should be in accordance with ETS 300 833 [3].

## A.2.3 Antenna Inter-Port Isolation (IPI)

Given that there is no requirement to multiplex equipment of different supplier on the same antenna, IPI is not relevant for the equipments under the present document.

## A.2.4 Feeder/antenna return loss

For partially outdoor systems the antenna/feeder system return loss should be considered not less than 20 dB. The measurement shall be referred to reference point C/C' towards the antenna.

# A.3 Automatic Transmit Power Control (ATPC)

ATPC may be useful in some circumstances, e.g.:

- to reduce interference between neighbouring systems or adjacent channels of the same system;
- to improve compatibility with analogue and digital systems at nodal stations;
- to improve residual BER or BBER performance;
- to reduce upfading problems;

- to reduce transmitter power consumption;
- to reduce digital to digital and digital to analogue distant interference between hops which re-use the same frequency;
- to increase system gain as a countermeasure against rainfall attenuation.

ATPC as an optional feature is aimed at driving the Transmit power amplifier output level from a proper minimum which facilitates the radio network planning requirements and which is used under normal propagation conditions up to a maximum value which fulfils all the specifications defined in the present document.

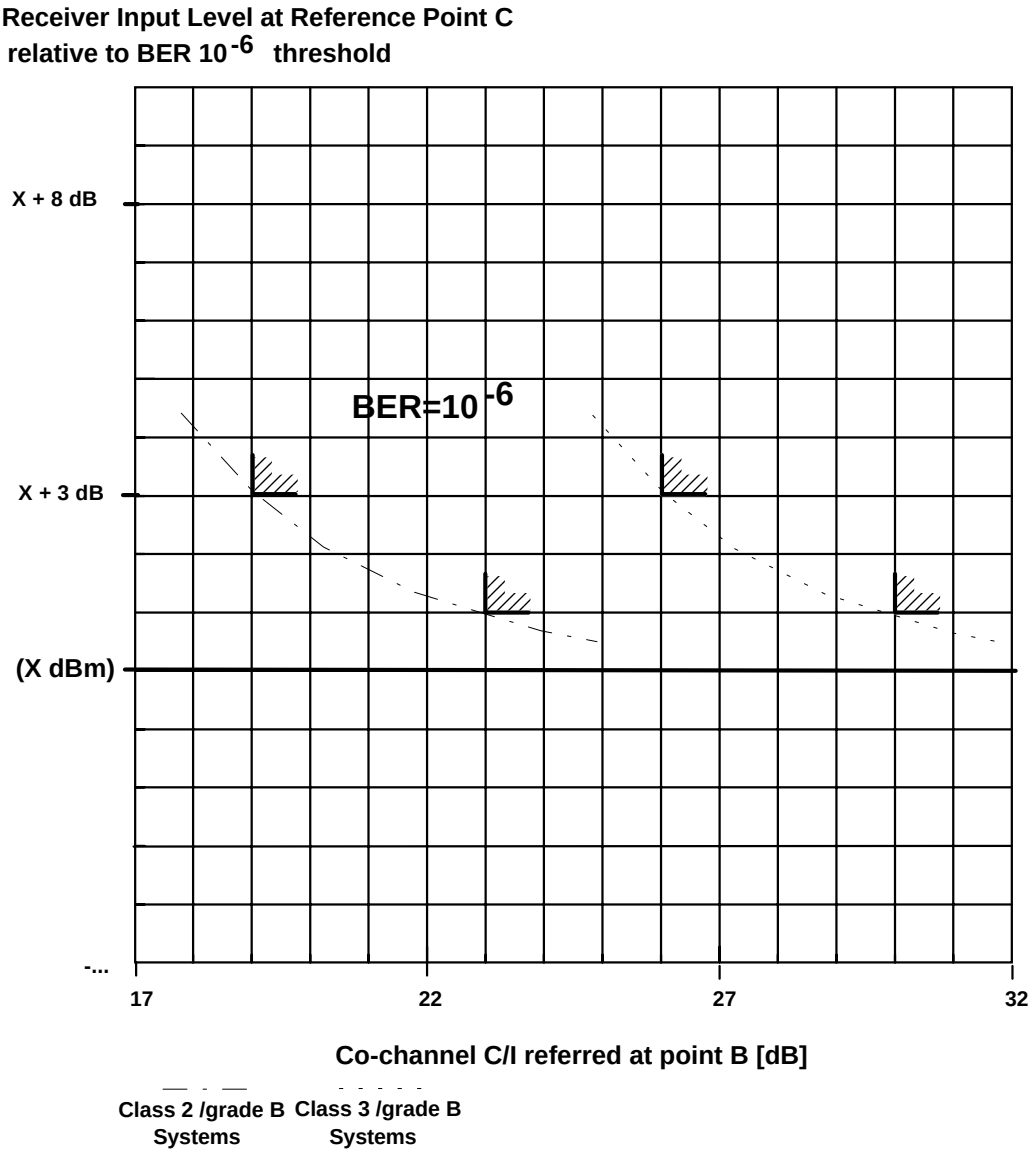
ATPC may also be used to increase the output power above the nominal level up to the maximum level specified by the manufacturer, with the agreement of administrations and operators, during fading conditions. This can be useful because in frequency ranges above 13 GHz the main limiting factors are given by non-selective fading events.

For planning considerations in a nodal environment a system equipped with ATPC can be considered to operate with its minimum transmitter power.

When ATPC is a fixed feature the ATPC range is defined as the power interval from the maximum (including tolerances) output power level to the lowest transmitter output power level (at reference point B') with ATPC; when it is optional two ranges may be defined, a "down-range" from the nominal level to the minimum (including tolerances) and an "up-range" from the nominal level to the maximum (including tolerances).

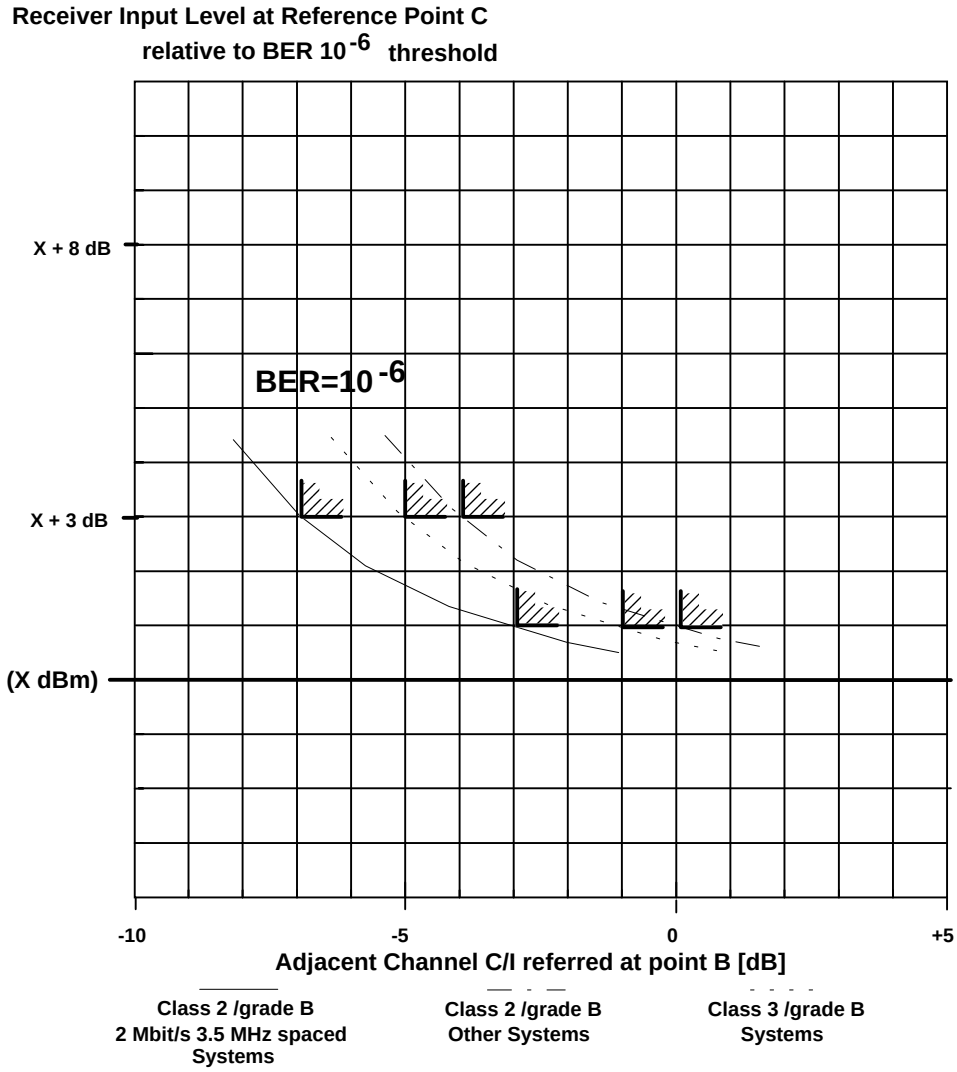
## A.4 Co-channel and adjacent channel interference

The performances for co-channel and adjacent channel spaced by one channel spacing C/I are reported in subclauses 5.5.3.1 and 5.5.3.2 for 1 dB and 3 dB degradation only. Figures A.3.1 and A.3.2 give the reference behavior for other values of degradation.




NOTE: X dBm = $10^{-6}$ BER threshold provided by subclause 5.5.1.

**Figure A.3.1: Co- channel interference threshold degradation**




NOTE: X dBm = $10^{-6}$ BER threshold provided by subclause 5.5.1.

**Figure A.3.2: First adjacent channel interference threshold degradation**

# Annex B (normative): EN 300 197, Transmission and Multiplexing (TM); Parameters for radio relay systems for the transmission of digital signals and analogue video signals operating at 38 GHz

**Table B.1: Subclauses of EN 300 197 relevant for compliance with the essential requirements of the EC Council Directives**

| Clause/ subclause number, or annex reference | Title | Corresponding article of Council Directive 89/336/EEC | Qualifying remarks |
|---|---|---|---|
| | **Spurious emission tests** | | |
| 5.3.7.1 | Transmitter Spurious emissions (digital systems) | 4(a) | |
| 6.4.4 | Transmitter Spurious emissions (wide band analogue systems) | 4(a) | |
| 5.4.3.1 | Receiver Spurious emissions (digital systems) | 4(a) | |
| 6.5.2 | Receiver Spurious emissions (wide band analogue systems) | 4(a) | |
| | **Receiver Immunity tests** | | |
| 5.5.3.3 | CW spurious interference (digital systems) | 4(b) | |
| 6.6.2 (c) | CW spurious interference (wide band analogue systems) | 4(b) | |

# Annex C (normative): ERC Decision on the adoption of approval regulations for equipment to be used for radio relay systems operating in the fixed service for the transmission of digital signals and analogue video signals operating between 37 GHz and 39,5 GHz, based on the European Standard (Telecommunications series) EN 300 197 V1.2.2

This annex contains the draft ERC Decision which references the technical specifications in EN 300 197 for inclusion in national approval regulations.

# EUROPEAN RADIOCOMMUNICATIONS COMMITTEE

ERC Decision
of 20 March 1998
on the adoption of approval regulations
for equipment to be used for radio relay systems
operating in the fixed service for the transmission
of digital signals and analogue video signals
operating between 37 GHz and 39.5 GHz,
based on the European Standard
(Telecommunications series) EN 300 197 V1.2.1

(ERC/DEC/(98)08)

# EXPLANATORY MEMORANDUM

## 1 INTRODUCTION

The free movement of radiocommunications goods and the provision of Europe-wide services for radiocommunications are only achievable if there exist common regulations throughout Europe regarding availability of frequency bands, approval requirements and border crossing procedures. A basic requirement to fulfil these objectives is the Europe-wide implementation of regulations based on the European Standards (Telecommunications series) (ENs) developed by the European Telecommunications Standards Institute (ETSI).

This Decision (ERC/DEC/(98)08) provides the necessary mechanism for CEPT Administrations to commit themselves to implement, within their national regimes, European Standard (Telecommunications series) EN 300 197 V1.2.1[1] and withdraw any conflicting national standard.

## 2 BACKGROUND

Both the ERC and ETSI are involved in the development of common regulations, as described in (1) above. The Memorandum of Understanding between ERC and ETSI explains the respective responsibilities of the two organisations and its annex describes the principles of co-operation. The ERC, for its part, should, *inter alia*, adopt Decisions on the introduction of ETSI standards into approval regimes.

EN 300 197 V1.2.1 has been prepared by the Transmission and Multiplexing (TM) Technical Committee of ETSI. The standard has undergone the ETSI standards approval procedure and is now published as an EN.

The EN is based on CEPT Recommendation T/R 12-01.

The use of the frequency range (37 to 39.5 GHz ) covered by EN 300 197 V1.2.1 is not harmonised within CEPT. Administrations have adopted different arrangements, to meet national requirements, for channel separations (3.5, 7, 14, 28, 56 and 140 MHz). Further, the equipment used in this frequency range is subject to national licensing and frequency planning which requires specification of, *inter alia*, frequency of operation and equivalent isotropically radiated power (e.i.r.p.).

Nevertheless, there are a number of parameters, in particular those considered by the ERC as essential for spectrum management purposes[2], which can be harmonised by adopting within approval regulations the limit values and measurement methods provided in EN 300 197 V1.2.1 .

## 3 REQUIREMENT FOR AN ERC DECISION

The allocation and assignment of radio frequencies and the complementary equipment approval regimes in CEPT Member countries are laid down by law, regulation or administrative action. The ERC recognises that for harmonised fixed and mobile radio services to be introduced successfully throughout Europe, manufacturers and operators must be given the confidence to make the necessary investment in the development and procurement of new systems. Commitment by CEPT Administrations to implement this ERC Decision will provide a clear indication that equipment conforming to approval regulations based on EN 300 197 V1.2.1 will have the benefit of a Europe-wide market.

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[1] EN 300 197 V1.2.1 : *"Transmission and Multiplexing (TM); Digital Radio Relay (DRRS); Parameters for DRRS for the transmission of digital signals and analogue video signals operating at 38 GHz"*

[2] See Annex 1 of the Decision

**ERC Decision**
**of 20 March 1998**

**on the adoption of approval regulations for equipment to be used for radio relay systems operating in the fixed service for the transmission of digital signals and analogue video signals operating between 37 GHz and 39.5 GHz, based on the European Standard (Telecommunications series) EN 300 197 V1.2.1**

**(ERC/DEC/(98)08)**

The European Conference of Postal and Telecommunications Administrations,

*considering:*

a) that CEPT has a long term objective to harmonise the use of frequencies and the related regulatory regimes;

b) that such harmonisation will benefit administrations, manufacturers, operators and users;

c) that ETSI has published EN 300 197 V1.2.1 for equipment to be used for radio relay systems in the fixed service operating in the 37 to 39.5 GHz frequency range with channel separations of 3.5, 7, 14, 28, 56 and 140 MHz;

d) that EN 300 197 V1.2.1 supersedes ETS 300 197 and that, in due course, the ERC will abrogate its Decision, (ERC/DEC(96)08) associated with ETS 300 197;

e) that, for the foreseeable future, there will continue to be widespread use of radio relay systems in the fixed service having the technical characteristics described in (c) above;

f) that, in accordance with the Memorandum of Understanding between ERC and ETSI, the ERC shall adopt ERC Decisions on the introduction of ETSs and ENs into approval regimes;

g) that the use of radio equipment is subject to national licensing and frequency planning requirements, in particular for frequency of operation and e.i.r.p.;

h) that suitable transitional arrangements are given in CEPT Recommendation T/R 01-05.

DECIDES

1. to adopt approval regulations for equipment to be used for radio relay systems operating in the frequency range 37 to 39.5 GHz with transmitter power levels of up to 1W, based on the limit values and measurement methods for spectrum management parameters contained in EN 300 197 V1.2.1, with the exclusion by national choice of those parameters which are subject to national licensing requirements[3]. A list of the spectrum management parameters to be included in approval regulations is given in Annex 1;

2. to withdraw any conflicting national approval regulation(s);

3. that this Decision shall enter into force on 1 April 1998;

4. that CEPT Member Administrations shall communicate the national measures implementing this Decision to the ERC Chairman and the ERO when the Decision is nationally implemented.

[3] Annex 2 and 3 are provided for information to show which options have been adopted by each administration in those cases where EN 300 197 V1.2.1 offers a choice.

**ANNEX 1**

Parameters from EN 300 197 V1.2.1 to be included in approval regulations:

| EN 300 197 V1.2.1 | Section | Comments |
|---|---|---|
| **Limits for parameters[4] of digital systems (section 5)** | | |
| Transmission capacity | 5.1 | Options for transmission capacity with the appropriate channel spacings 3.5, 7, 14, 28, 56 and 140 MHz. Manufacturers declaration |
| Baseband parameters | 5.2 | |
| Transmitter characteristics | 5.3 | Options for channel spacings 3.5, 7, 14, 28, 56 and 140 MHz |
| Transmitter power range | 5.3.1 | |
| Transmitter output power tolerance | 5.3.3 | |
| RF spectrum mask | 5.3.5 | |
| Spurious emissions | 5.3.7 | |
| RF frequency tolerance | 5.3.8 | |
| Receiver characteristics | 5.4 | |
| Spurious emissions | 5.4.3 | |
| System performance | 5.5 | Options for channel spacings 3.5, 7, 14, 28, 56 and 140 MHz |
| BER performance | 5.5.1 | |
| Interference sensitivity | 5.5.3 | |
| co-channel interference | 5.5.3.1 | |
| adjacent channel interference | 5.5.3.2 | |
| CW spurious interference | 5.5.3.3 | |
| **Limits for parameters[4] of wide band analogue systems (section 6)** | | |
| Transmit/receive capacity | 6.1 | Options for transmission capacity with the appropriate channel spacings 28 and 56 MHz. Manufacturers declaration |
| Baseband parameters | 6.3 | |
| Transmitter characteristics | 6.4 | Options for channel spacings 28 and 56 MHz |
| Transmitter power range | 6.4.1 | |
| Transmitter output power tolerance | 6.4.2 | |
| Spectrum mask | 6.4.3.1 | |
| Spurious emissions | 6.4.4 | |
| RF frequency tolerance | 6.4.5 | |
| Receiver characteristics | 6.5 | |
| Spurious emission | 6.5.2 | |
| Transmit/receive performance | 6.6 | |
| Receiver threshold | 6.6.1 | |
| co-channel interference | 6.6.2.a | |
| adjacent channel interference | 6.6.2.b | |
| CW spurious interference | 6.6.2.c | |

[4] In some countries the spurious emissions and spurious radiations of transmitters and receivers are not considered as approval requirements but are essential requirements of the EMC Directive 89/336 EC for which alternative procedures apply.

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## ANNEX 2

Adoption of the digital elements of EN 300 197 V1.2.1 : National variations

| Administration | Adoption of channel spacing options | Adoption of options for environmental conditions |
|---|---|---|
| Albania | | |
| Andorra | | |
| Austria | 4 to 7, 9 to 14, 16, 17 | 18, 23 |
| Belgium | | |
| Bosnia and Herzegovina | | |
| Bulgaria | | |
| Croatia | | |
| Cyprus | | |
| Czech Republic | | |
| Denmark | | |
| Estonia | | |
| Finland | 4 to 17 | 18 to 24 |
| France | | |
| Germany | | |
| Greece | | |
| Hungary | | |
| Iceland | | |
| Ireland | | |
| Italy | | |
| Latvia | | |
| Liechtenstein | | |
| Lithuania | | |
| Luxembourg | | |
| Malta | | |
| Moldova | | |
| Monaco | | |
| Netherlands | | |
| Norway | | |
| Poland | | |
| Portugal | 4 to 17 | - |
| Romania | | |
| Russian Federation | | |
| San Marino | | |
| Slovak Republic | | |
| Slovenia | | |
| Spain | | |
| Sweden | | |
| Switzerland | | |
| The Former Yugoslav Republic of Macedonia | | |
| Turkey | | |
| Ukraine | | |
| United Kingdom | | |
| Vatican City | | |

Key:

Channel spacing options

| Option | Spectrum efficiency class | Bit-rate (Mbit/s) | Channel Spacing (MHz) | System grade |
|---|---|---|---|---|
| 1 | 1 | 2 | 7 | A |
| 2 | 1 | 8 | 14 | A |
| 3 | 1 | 34 | 56 | A |
| 4 | 2 | 2 | 3.5 | A |
| 5 | 2 | 2x2 | 3.5 | A |
| 6 | 2 | 8 | 7 | A |
| 7 | 2 | 34 | 28 | A |
| 8 | 2 | 140 or 155 | 140 | A |
| 9 | 2 | 2 | 3.5 | B |
| 10 | 2 | 2x2 | 3.5 | B |
| 11 | 2 | 8 | 7 | B |
| 12 | 2 | 2x8 | 14 | B |
| 13 | 2 | 34 | 28 | B |
| 14 | 2 | 51 | 56 | B |
| 15 | 2 | 140 or 155 | 140 | B |
| 16 | 3 | 51 | 28 | B |
| 17 | 3 | 140 or 155 | 56 | B |

Class 1: equipment performance based on typically 2-state modulation scheme (e.g. 2-FSK (Frequency Shift Keying), Gaussian Minimum Shift Keying (GMSK) with discriminator detection, or equivalent);

Class 2: equipment performances based on typically 4-state modulation scheme (e.g. 4-FSK, 4-QAM (Quadrature Amplitude Modulation), or equivalent);

Class 3: equipment performances based on typically 16-state modulation scheme (e.g. 16- QAM, or equivalent).

Some equipment types, may benefit from some performance improvement due to the technology gap, for this reason two grades of system performance, grade A and grade B are provided.

Environmental condition options

18 = Class 3.1
19 = Class 3.2
20 = Class 3.3
21 = Class 3.4
22 = Class 3.5
23 = Class 4.1
24 = Class 4.1E

Some countries may require a more stringent temperature range than is currently covered in this EN.

**ANNEX 3**

Adoption of the analogue elements of EN 300 197 V1.2.1 : National variations

| Administration | Adoption of channel spacing options | Adoption of options for environmental conditions |
|---|---|---|
| Albania | | |
| Andorra | | |
| Austria | NONE | NONE |
| Belgium | | |
| Bosnia and Herzegovina | | |
| Bulgaria | | |
| Croatia | | |
| Cyprus | | |
| Czech Republic | | |
| Denmark | | |
| Estonia | | |
| Finland | 1 to 4 | 5 to 11 |
| France | | |
| Germany | | |
| Greece | | |
| Hungary | | |
| Iceland | | |
| Ireland | | |
| Italy | | |
| Latvia | | |
| Liechtenstein | | |
| Lithuania | | |
| Luxembourg | | |
| Malta | | |
| Moldova | | |
| Monaco | | |
| Netherlands | | |
| Norway | | |
| Poland | | |
| Portugal | 1 to 4 | 5 to 10 |
| Romania | | |
| Russian Federation | | |
| San Marino | | |
| Slovak Republic | | |
| Slovenia | | |
| Spain | | |
| Sweden | | |
| Switzerland | | |
| The Former Yugoslav Republic of Macedonia | | |
| Turkey | | |
| Ukraine | | |
| United Kingdom | | |
| Vatican City | | |

Key: Channel Spacing

1 = <3.5 MHz Video bandwidth in a 28 MHz Channel
2 = <6 MHz Video bandwidth in a 56 MHz Channel
3 = <10 MHz Video bandwidth in a 56 MHz Channel
4 = <14 MHz Video bandwidth in a 56 MHz Channel

Environmental conditions

5 = Class 3.1
6 = Class 3.2
7 = Class 3.3
8 = Class 3.4
9 = Class 3.5
10 = Class 4.1
11 = Class 4.1E

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**European Radiocommunications Committee Decision**

**CEPT/ERC/DEC/(98)08**

**on the adoption of approval regulations for equipment to be used for radio relay systems operating in the fixed service for the transmission of digital signals and analogue video signals operating between 37 GHz and 39.5 GHz, based on the European Standard (Telecommunications series) EN 300 197 V1.2.1**

As of 1 June 1998 the following CEPT Members have committed themselves to apply the terms of this Decision:

Austria
Croatia
Finland
France
Italy
Norway
Portugal
Turkey
United Kingdom

After 1 June 1998 the undermentioned CEPT Members have committed themselves to apply the terms of this Decision:

Denmark
Ireland
Netherlands
Spain

# Annex D (informative): Bibliography


- ITU-R Recommendation F.749: "Radio-frequency channel arrangements for analogue and digital radio relay systems in the 36 to 40,5 GHz frequency band".

- TR 101 035 V1.1.2: "Transmission and Multiplexing (TM); Synchronous Digital Hierarchy (SDH) aspects regarding Digital Radio Relay Systems (DRRS)".

# History

| Document history | | |
|---|---|---|
| Edition 1 | April 1994 | Publication as ETS 300 197 |
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