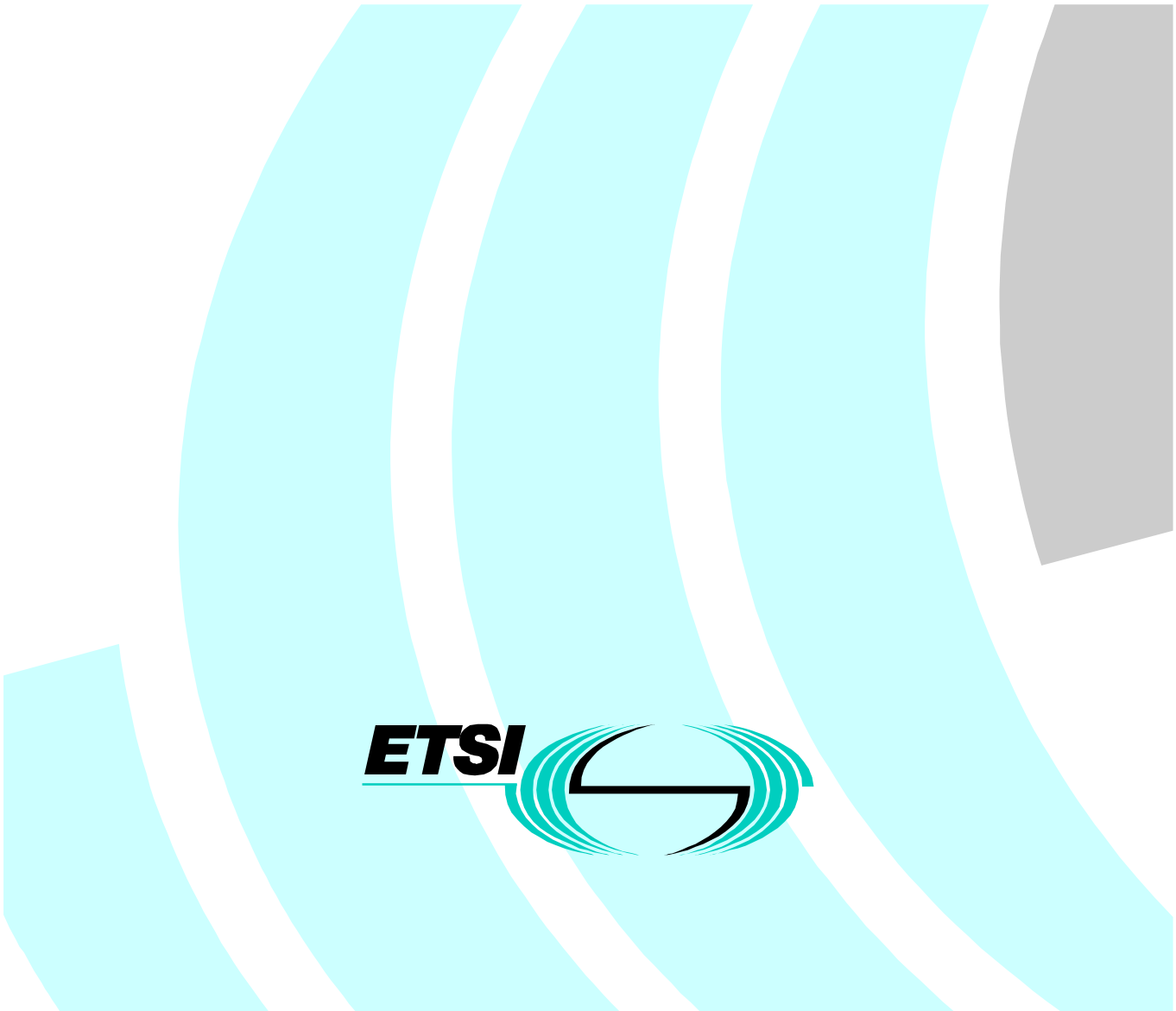
ETSI EN 301 787 V1.1.1 (2001-04)

European Standard (Telecommunications series)

**Fixed Radio Systems;
Point-to-Point equipment;
Parameters for radio systems for the transmission of Sub-STM-0 digital signals operating in the 18 GHz frequency band**



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Contents

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Foreword

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

The present document has been previously published as an ETSI Technical Specification under TS 101 787 V1.1.1.

National transposition dates	
Date of adoption of this EN:	13 April 2001
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1 Scope

The present document specifies the minimum performance parameters for terrestrial digital fixed service radio communications equipments operating in the 18 GHz frequency band and provides for the following:

- system types codes for regulatory unique reference to the various system types detailed in the present document, refer to annex B (normative).

Digital systems are intended to be used for point-to-point connections in local and regional networks at data rates of Synchronous Transport Module.

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.1189-1 [23] and the performance objectives detailed in ITU-T Recommendation G.826 [30] and in ITU-T Recommendation G.828 [31].

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 either:

   - to separate antennas; or

   - to separate polarizations of the same antenna.

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

The present document deals with Radio Frequency (RF) and baseband characteristics relevant to Sub STM-0 Synchronous Digital Hierarchy (SDH) transmission systems. Antenna/feeder system requirements are covered in EN 300 833 [13].

These digital systems capacities shall be in accordance with ITU-T Recommendation G.708 [27].

The present document does not contain aspects related to test procedures and test conditions, however they are to be found in EN 301 126-1 [14].

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

Class 1: equipment spectral efficiency based on typically 16 or 32-states modulation scheme (e.g. 16-QAM, 32-QAM, or equivalent);

Class 2: equipment spectral efficiency based on typically 64 or 128-states modulation scheme (e.g. 64-QAM, 128-QAM, or equivalent).

The above classes are indicative only and do not imply any constraint to the actual modulation format, provided that all the requirements in the present document are met.

Safety aspects are outside the mandate of ETSI and they will not be considered in the present document. However compliance to EN 60950 [1] will be required to comply with EC Directive R&TTE.

Technical background for most of the parameters and requirements referred in the present document may be found in TR 101 036-1 [17].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] EN 60950: "Safety of information technology equipment".

[2] CEPT/ERC/REC 12-03: "Harmonized radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 17,7 GHz to 19,7 GHz".

[3] CEPT/ERC Recommendation 74-01: "Spurious emissions".

[4] Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

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

[6] ETSI ETS 300 132-1: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources".

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

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

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

[10] ETSI ETS 300 638: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRRS); Fixed point-to-point radio link equipment for the transmission of digital signals and analogue video signal operating in the frequency bands 10 GHz and 14 GHz with 20 MHz alternate channel spacing".

[11] ETSI EN 300 645: "Telecommunications Management Network (TMN); Synchronous Digital Hierarchy (SDH) radio relay equipment; Information model for use on Q interfaces".

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

[13] ETSI EN 300 833: "Fixed Radio Systems; Point-to-point Antennas; Antennas for point-to-point fixed radio systems operating in the frequency band 3 GHz to 60 GHz".

[14] ETSI EN 301 126-1 (V1.1.2): "Fixed Radio Systems; Conformance testing; Part 1: Point-to-point equipment - Definitions, general requirements and test procedures".

[15] ETSI EN 301 489-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links and ancillary equipment and services".

[16] ETSI TR 101 035 (V1.1.3): "Transmission and multiplexing (TM); Synchronous Digital Hierarchy (SDH) aspects regarding Digital Radio Relay Systems (DRRS)".

[17] ETSI TR 101 036-1: "Fixed Radio Systems; Point-to-point equipment; Generic wordings for standards on digital radio systems characteristics; Part 1: General aspects and point-to-point equipment parameters".

[18] IEC 154-2: "Flanges for waveguides. Part 2: Relevant specifications for flanges for ordinary rectangular waveguides".

[19] ITU-R Recommendation F.595-6: "Radio-frequency channel arrangements for radio-relay systems operating in the 18 GHz frequency band".

[20] ITU-R Recommendation F.750-3: "Architectures and functional aspects of radio-relay systems for (SDH)-based networks".

[21] ITU-R Recommendation F.751-2: "Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks".

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

[23] ITU-R Recommendation F.1189-1: "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".

[24] ITU-R Recommendation F.1191-1: "Bandwidths and unwanted emissions of digital radio-relay systems".

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

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

[27] ITU-T Recommendation G.708: "Sub STM-0 network node interface for the synchronous digital hierarchy (SDH)".

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

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

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

[31] ITU-T Recommendation G.828: "Error performance parameters and objectives for international, constant bit rate synchronous digital paths".

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

[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] ITU-R Recommendation P.530-8: "Propagation data and prediction methods required for the design of terrestrial line-of-sight systems".

[36] ITU-T Recommendation G.774 (1992): "Synchronous digital hierarchy (SDH) management information model for the network element view".

3 Symbols and abbreviations

3.1 Symbols

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

dB	decibel
dBc	decibel relative to mean carrier power
dBi	decibel relative to an isotropic radiator
dBm	decibel relative to 1 milliWatt
dBW	decibel relative to 1 Watt
GHz	Gigahertz
kHz	kilohertz
Mbit/s	Mega-bits per second
MHz	Megahertz
ppm	parts per million

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 Block Error Ratio
BER	Bit Error Rate
C/I	Carrier to Interference rate
CMI	Coded Mark Inversion
CSmin	Minimum practical channel separation (for a given radio-frequency channel arrangement)
CW	Continuous Wave
dc	direct current
DRRS	Digital Radio Relay Systems
EMC	ElectroMagnetic Compatibility
ESR	Errored Second Ratio
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
IPI	Inter-Port Isolation
LO	Local Oscillator
PDH	Plesiochronous Digital Hierarchy
PRBS	Pseudo Random Binary Sequence
QAM	Quadrature Amplitude Modulation
RBER	Residual BER
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-0	Medium capacity SDH radio transport module 51,840 Mbit/s AU-3 equivalent
STM-N	Synchronous Transport Module, level N
Sub-STM-0	Low capacity SDH radio transport module (n times VC-12 or VC2 equivalent)
TMN	Telecommunications Management Network
TU	Tributary Unit
TUG	Tributary Unit Group
XPD	Cross-Polar Discrimination

4 General characteristics

4.1 Frequency bands and channel arrangements

4.1.1 Channel arrangements

The frequency range is 17,7 GHz to 19,7 GHz. The channel plan shall be in accordance with CEPT/ERC/REC 12-03 [2].

NOTE: CEPT Recommendation 12-03 allows for low-capacity channel arrangements on a national basis. ITU-R Recommendation F.595-6 [19] details the various channel arrangements including low-capacity channel arrangements.

4.1.2 Channel spacing for systems operating on the same route

System capacity (system bit rate) and their relevant channel spacing in the present document are reported in table 1. The system is defined in the clause 5.1.

NOTE: According to systems characteristics the equipment can be connected either to separate antennas or on a separate polarization to the same antenna.

Table 1: Digital systems channel spacing for various bit rates

System capacity [Mbit/s]	9 792 (sSTM-14)	14 400 (sSTM-22)
Channel spacing	3,5 MHz	3,5 MHz

sSTM-2n interface
A SDH transmission interface which transports a number 'n' times TUG2 (Tributary Unit Group-2), as defined in ITU-T Recommendation G.708 [27].

sSTM-1k interface
A SDH transmission interface which transports a number 'k' times TU–12 (Tributary Unit-12), as defined in ITU-T Recommendation G.708 [27].

For regulatory purposes in national procedures for licensing radio equipments according to the present document, the above system types shall be identified by the "system type codes" reported in normative annex B.

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 manufacturer equipment on the same polarization of the same antenna;
- there may be a requirement to multiplex different manufacturer equipment on different polarization of the same antenna. This will not apply to systems with integral 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 [30] and by ITU-T Recommendation G.828 [31] when published, following the criteria defined in ITU-R Recommendation F.1189-1 [23] 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.530-8 [35] and F.1102 [22] shall be applied.

4.4 Environmental conditions

The equipment shall be required to meet the environmental conditions set out in ETS 300 019 [5] 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 [5] classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [5] 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 [5], 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

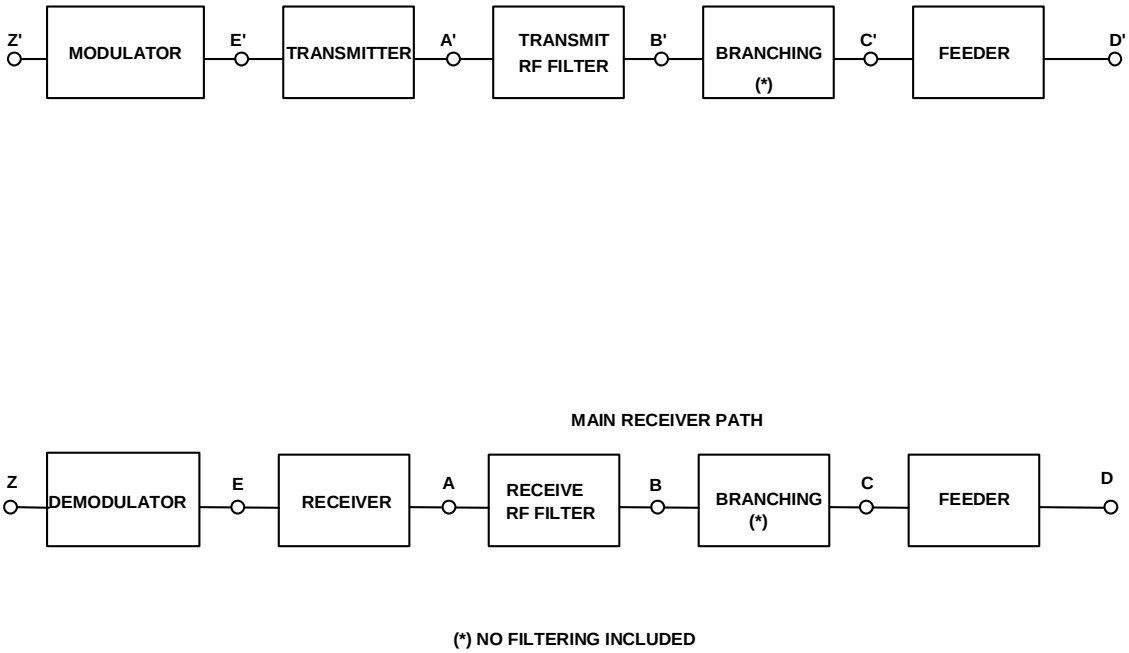
The power supply interface shall be in accordance with the characteristics of one or more of the secondary voltages foreseen in ETS 300 132-1 [6] and ETS 300 132-2 [7].

NOTE: Some applications may require secondary voltages that are not covered by ETS 300 132-1 [6] and ETS 300 132-2 [7].

4.6 Electromagnetic compatibility

Equipment shall operate under the conditions specified in EN 300 385 [8] or EN 301 489-4 [15].

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 Recommendation G.784 [29] and G.774 [36] and ITU-R Recommendations F.750-3 [20] and F.751-2 [21] give the general requirements for TMN interface and functionality. ETS 300 635 [9], ETS 300 785 [12] and EN 300 645 [11] 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 TMN 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 EN 300 833 [13].

4.9.2 Antenna cross-Polar Discrimination (XPD)

See EN 300 833 [13].

4.9.3 Antenna Inter-Port Isolation (IPI)

See EN 300 833 [13].

4.9.4 Waveguide flanges (or other connectors)

When flanges are required at reference point C, C', the following shall be used according to IEC 154-2 [18].

4.9.5 Return Loss (RL)

Equipment according to the present document are likely to have integral antennas or very similar technical solutions, without long feeder connections; RL is not considered an essential requirement. When an antenna is an integral part of the equipment there shall be no requirement.

For feeder/antenna RL requirement see annex A.

5 System Parameters

5.1 Transmission capacity

For the scope of the present document, the system capacity should be intended as the capacity carried by a single channel, where any single channel can carry 4 or 6 2 Mbit/s PDH channels. The payload capacity should be intended as a number of the VC group carried by a single sSTM-1k or sSTM-2n frame. The sSTM-1k and sSTM-2n interfaces are defined by ITU-T Recommendation G.708 [27].

The relationship between system capacity, payload capacity and PDH capacity is shown below:

Table 2: Relationship between system capacity, payload capacity and PDH capacity

PDH channel capacity [Mbit/s]	4 x 2 048	6 x 2 048
Payload capacity	4 x TU-12 (VC12)	2 x TUG2 (VC2)
System capacity [Mbit/s]	9 792 (sSTM-14)	14 400 (sSTM-22)

5.2 Baseband parameters

5.2.1 Plesiochronous interfaces

Plesiochronous interfaces at 2 Mbit/s shall comply with ITU-T Recommendation G.703 [25].

These baseband signals shall be carried 'open port', i.e. in a transparent manner independent of their content and they shall be mapped into a Sub-STM-0 signal as described in ITU-T Recommendation G.708 [27].

Parameters for service channels and wayside traffic channels are outside the scope of the present document.

5.2.2 SDH baseband interface

The SDH baseband interface shall be in accordance with ITU-T Recommendations G.703 [25], G.707 [26], G.783 [28], G.784 [29], G.957 [32], ETS 300 635 [9], ETS 300 638 [10].

For sub-STM-0 rates ITU-T Recommendation G.708 [27] mapping applies. Sub STM-0 physical interfaces are under discussion by the ITU.

A partially filled STM-1 interface may be used to connect Sub-STM-0 interfaces.

Two STM-1 interfaces shall be possible:

- Coded Mark Inversion (CMI) electrical (ITU-T Recommendation G.703 [25]); and
- Optical (ITU-T Recommendation G.957 [32]).

The use of reserved bytes contained in the Section OverHead (SOH), and their termination shall be in accordance with ITU-R Recommendations F.750-3 [20], F.751-2 [21] and for sub-STM-0 with ITU-T Recommendation G.708 [27].

NOTE: Further details on the possible use of the SOH bytes reserved for future international standardization are given in TR 101 035 [16].

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 applies.

5.3.1 Transmitter power range

Transmitter maximum mean output power at reference point C' of the system block diagram (figure 1) shall not exceed +25 dBm for equipment (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 steps of 1 dB or less.

5.3.2 Transmit power and frequency control

5.3.2.1 Automatic Transmit Power Control (ATPC)

ATPC is a mandatory feature. The usage of ATPC is optional and, depending on EMC environment.

The ATPC range shall be pre-settable.

If ATPC is used as an interference mitigation technique, its range should be from 0 dB (ATPC disabled) up to at least 10 dB. This upper value is provisional.

Testing shall be carried out with output power level corresponding to:

- ATPC set manually to a fixed value for system performance (clauses 5.5 and 5.6);
- ATPC set at maximum available power for transmit performance (clause 5.3).

It shall be verified that the emitted RF spectrum is within the absolute RF spectrum mask evaluated for the maximum available output power of the equipment, including the attenuation introduced by RTPC, if any.

NOTE: Where the use of ATPC is considered compulsory for regulatory purposes the transmitter output power shall meet the spectrum mask limits throughout the ATPC range.

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 (clause 5.3) and for system performance (clauses 5.5 and 5.6).

The RF spectrum mask shall be verified in three points (low, medium, and high) of the RTPC power excursion and with ATPC set to maximum available power (if any). When these spectrum measurements are made difficulties may be experienced. Actual measurement methods shall be addressed in further investigations and will be defined in the conformance testing standard, EN 301 126-1 [14].

RTPC range should be restricted, taking into account the wideband noise generated by the transmitter chain, to ensure the spectrum mask requirements are met throughout the transmitter output power range.

NOTE: Where the use of ATPC is considered compulsory for regulatory purposes the transmitter output power shall meet the spectrum mask limits throughout the ATPC range.

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 supplier shall declare the nominal output power.

The tolerance of the nominal output power shall be within the nominal output power as detailed below:

- for systems operating within non-weather-protected locations and within classes 3.3, 3.4 and 3.5 weather protected locations of ±2 dB;
- for systems operating within other classes of weather protected locations of ±1 dB.

5.3.4 Transmit Local Oscillator (LO) frequency arrangements

There shall be no requirement on transmitter LO frequency arrangement.

5.3.5 RF spectrum mask

The spectrum masks are shown in figures 2 and 3.

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

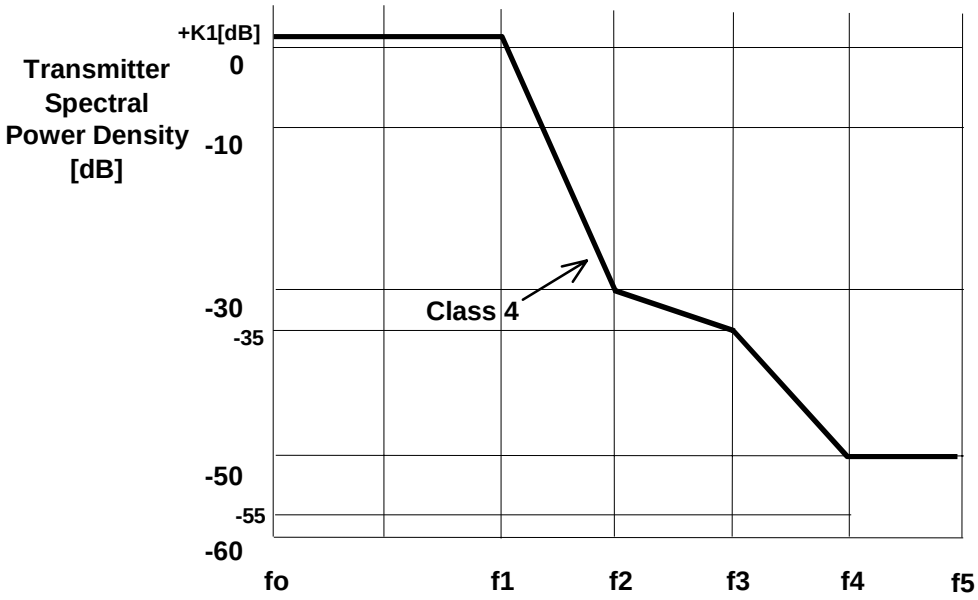
Masks shall be measured with a modulating base-band signal given by a PRBS signal given in ITU-T Recommendation O.151 [33] in the case of PDH signal or ITU-T Recommendation O.181 [34] in the case of STM-1 signal.

The masks for class 4 and 5 systems do not include frequency tolerance.

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

Table 3: Spectrum analyser settings for RF power spectrum measurement

Channel Spacing	**[MHz]**	3,5
Sweep width	**[MHz]**	20
Scan time		Auto
IF bandwidth	**[kHz]**	30
Video bandwidth	**[kHz]**	0,1



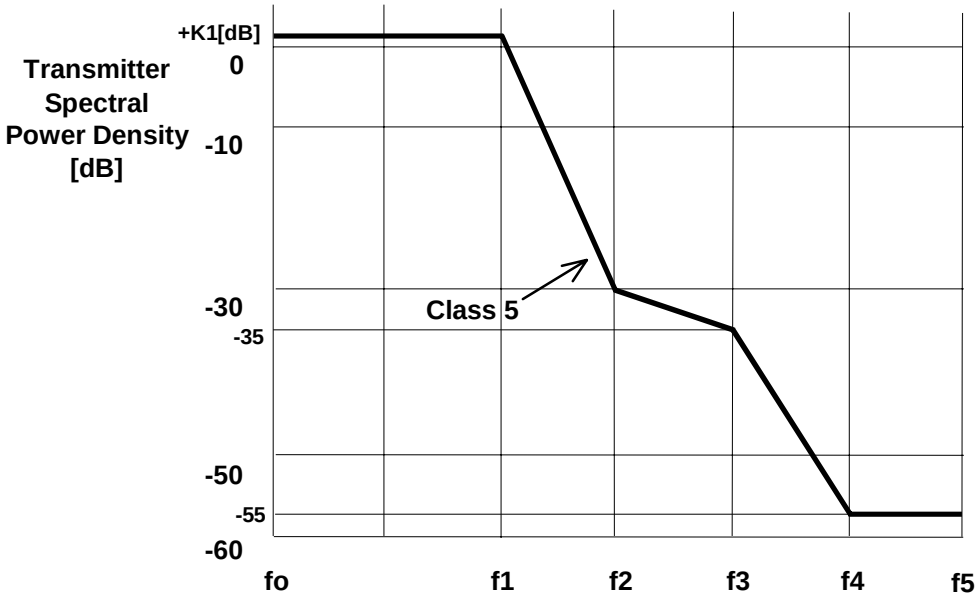
NOTE: Frequency from nominal transmitter centre frequency [MHz].

Figure 2: Limits of spectral power density for class 4 systems

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

Table 4: Spectrum mask frequency limits

Bit-rate [Mbit/s]	Channel spacing [MHz]	K1 [dB]	f1 [MHz]	f2 [MHz]	f3 [MHz]	f4 [MHz]	f5 [MHz]
SSTM-14	3,5	+1	1,4	2,8	3,5	5,45	8,75



NOTE: Frequency from nominal transmitter centre frequency [MHz].

Figure 3: Limits of spectral power density for class 5 systems

Reference frequencies f1 to f5 and relative attenuation K1 [dB] are reported in table 5 for the bit rate and channel spacing foreseen:

Table 5: Spectrum mask frequency limits

Bit-rate [Mbit/s]	Channel spacing [MHz]	K1 [dB]	f1 [MHz]	f2 [MHz]	f3 [MHz]	f4 [MHz]	f5 [MHz]
sSTM-22	3,5	+1	1,4	2,8	3,5	6,1	8,75

5.3.6 Discrete CW lines exceeding the spectrum mask limit

5.3.6.1 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 37 dB below the average power level of the carrier for class 4 and 43 dB for class 5.

5.3.6.2 Other spectral lines

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

Those lines shall not:

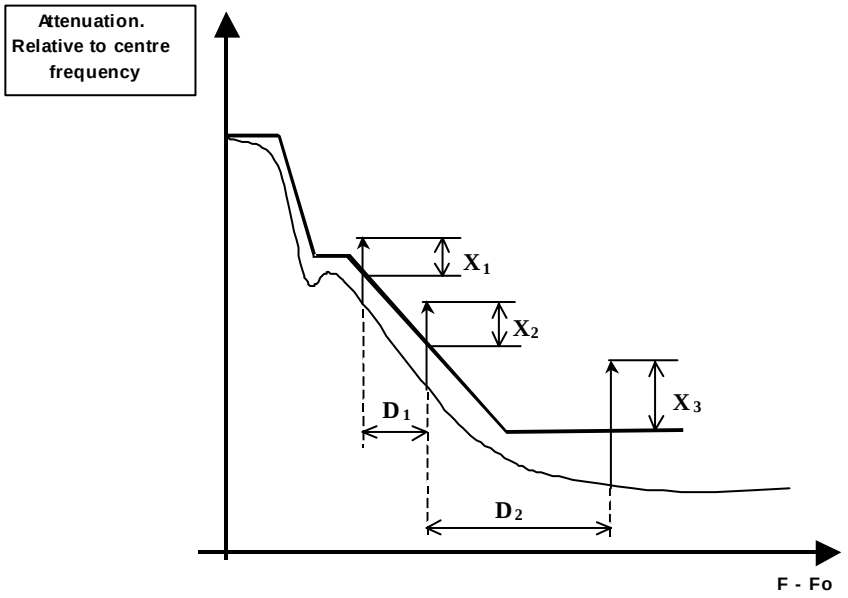
- exceed the mask by a factor more than {10 log (CSmin/IFbw) -10} dB;
- be spaced each other in frequency by less than CSmin.

Where:

CSmin = 1 750 kHz for the 18 GHz bands.

IFbw is the recommended resolution IF bandwidth, expressed in kHz, reported in table 3.

Figure 4 shows a typical example of this requirement.



X_1, X_2, X_3 [dB] $\leq$ 10log(CSmin/ IFbw) -10

$D_1, D_2 \geq$ CSmin

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

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 channel plan (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 B' for indoor systems and C' for outdoor systems (where a common Tx/Rx duplexer is used).

5.3.7.1 Spurious emissions-external

According to ITU-R Recommendation F.1191-1 [24], and CEPT/ERC Recommendation 74-01 [3], the external spurious emissions are defined as emissions at frequencies which are outside the nominal carrier frequency ±250 % of the relevant channel separation.

The limits of these emissions shall conform to CEPT/ERC Recommendation 74-01 [3].

5.3.7.2 Spurious emissions-internal

There is no requirement to operate transmitting equipment from one manufacturer with receiving equipment from another, or to multiplex different manufacturers equipment on the same polarization of a common antenna.

5.3.8 Radio frequency tolerance

Maximum radio frequency tolerance shall not exceed ±10 ppm. 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 clause 5.5.1 referenced to point C.

The input level range for a BER < 10^{-8} shall extend for a minimum of 41 dB above the threshold limit specified for BER = 10^{-8} in clause 5.5.1 referenced to point C.

However an upper limit above -20 dBm is not required for BER = 10^{-3} and –24 dBm for BER = 10^{-8}.

5.4.2 Receiver local oscillator frequency arrangements

There shall be no requirement on LO frequency arrangement.

5.4.3 Spurious emissions

The limits of these emissions shall conform to CEPT/ERC Recommendation 74-01 [3].

5.4.3.1 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 clause 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 6.

Table 6: BER performance thresholds (18 GHz band)

			RSL @ BER		
Spectrum efficiency class ↓	**Bit-rate [Mbit/s]** ↓	**Channel spacing [MHz]** ↓	**RSL @ 10^{-3} [dBm]**	**RSL @ 10^{-6} [dBm]**	**RSL @ 10^{-8} [dBm]**
4	sSTM-14	3,5	-81	-78	-76
5	sSTM-22	3,5	-76	-73	-71

5.5.2 Residual BER

The RBER level under simulated operating conditions without interference shall be guaranteed with a signal level at reference point C which is between 10 dB and 35 dB above the level which gives BER = 10^{-6} (as specified in clause 5.5.1).

To guarantee the designed degree of service, see clause A.4, the network operator may require equipment to meet a RBER limit with the first adjacent channel interferer. For this equipment the RBER level under simulated operating conditions with first adjacent channel interference shall be guaranteed with a signal level at reference point C, which is between 15 dB and 35 dB above the level which gives a BER = 10^{-6} (as specified in clause 5.5.1) and with the adjacent channel interference set to a level which reflects the full output power tolerance of the transmitter).

- the RBER shall be for systems capacity of sSTM-14, sSTM-22: RBER < 10^{-10};
- all measurements are made at the payload bit rate defined in clause 5.1.

EN 301 126-1 [14] recognizes that this requirement is subject to a supplier declaration only. However, in informative annex 3 some background information relating to the actual test methods and test confidence is given.

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 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 clause 5.5.1.

The Indicative behaviour for these and other values of degradation may be found in figure A.4.1a and A.4.1b.

Table 7: Co-channel interference sensitivity

co-channel interference		**RSL @ BER →**	**RSL @ 10^{-6}**	
		Degradation →	**1 dB**	**3 dB**
Spectrum efficiency class ↓	**Bit rate [Mbit/s]** ↓	**Channel spacing [MHz]** ↓	**C/I (dB)**	**C/I (dB)**
4	SSTM-14	3,5	30	26
5	SSTM-22	3,5	37	33

5.5.3.2 First 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 clause 5.5.1.

The Indicative behaviour for these and other values of degradation 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	3 dB
Spectrum efficiency class ↓	Bit rate [Mbit/s] ↓	Channel spacing [MHz] ↓	C/I (dB)	C/I (dB)
4	SSTM-14	3,5	-4	-8
5	SSTM-22	3,5	0	-4

5.5.3.3 CW Spurious Interference

For a receiver operating at the 10^{-6} BER threshold given in table 6, the introduction of a CW interferer at a certain level specified below, with respect to the wanted signal and at any frequency in the range 30 MHz to the second harmonic of the upper frequency of the band, excluding frequencies either side of the wanted centre frequency of the RF channel by up to 250 % the channel spacing, shall not result in a BER greater than 10^{-5}.

The level of the CW interferer shall be:

- +20 dB at any frequency either side of the wanted centre frequency of the RF channel from 250 % up to 500 % the channel spacing;
- +30 dB outside 500 % the channel spacing.

NOTE: When waveguide is used between ref. point A and C, which length is higher than twice the free space wavelength of the 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 higher than 4 times the same wavelength.

This test is designed to identify specific frequencies at which the receiver may have a spurious response, e.g. image frequency, harmonics of the receive filter, etc. The actual test range should be adjusted accordingly. 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)

For a receiver operating at the RSL specified in clause 5.5.1 for 10^{-6} BER threshold, the introduction of two equal CW interferers 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.

Annex A (informative): Additional information

A.1 Feeder/antenna RL

When separated antenna and radio equipment are concerned the antenna/feeder system RL should be considered not less than 18 dB. The measurement should be referred to reference point D/D' of figure 1 towards the antenna.

A.2 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 up fading 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 a mandatory 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.3 RBER

In particular applications, where there is a high density of radio links in a specific area, e.g. nodal site, closely located radios may use adjacent channels. Therefore to guarantee the grade of service the equipment will need to meet RBER criteria in the presence of an adjacent channel interferer.

The RBER is standardized in order to match the ESR (or the BBER) performance required by ITU-R transmission performance recommendations.

To have sufficient confidence in the measurement, where the BER is relatively low compared to the actual payload, the test time is very long. The actual background to this measurement and the BER figures are detailed in TR 101 036-1 [17].

When error correction is a fitted feature it may be possible to reduce the measurement time by estimating the RBER using the relevant formula declared by the supplier.

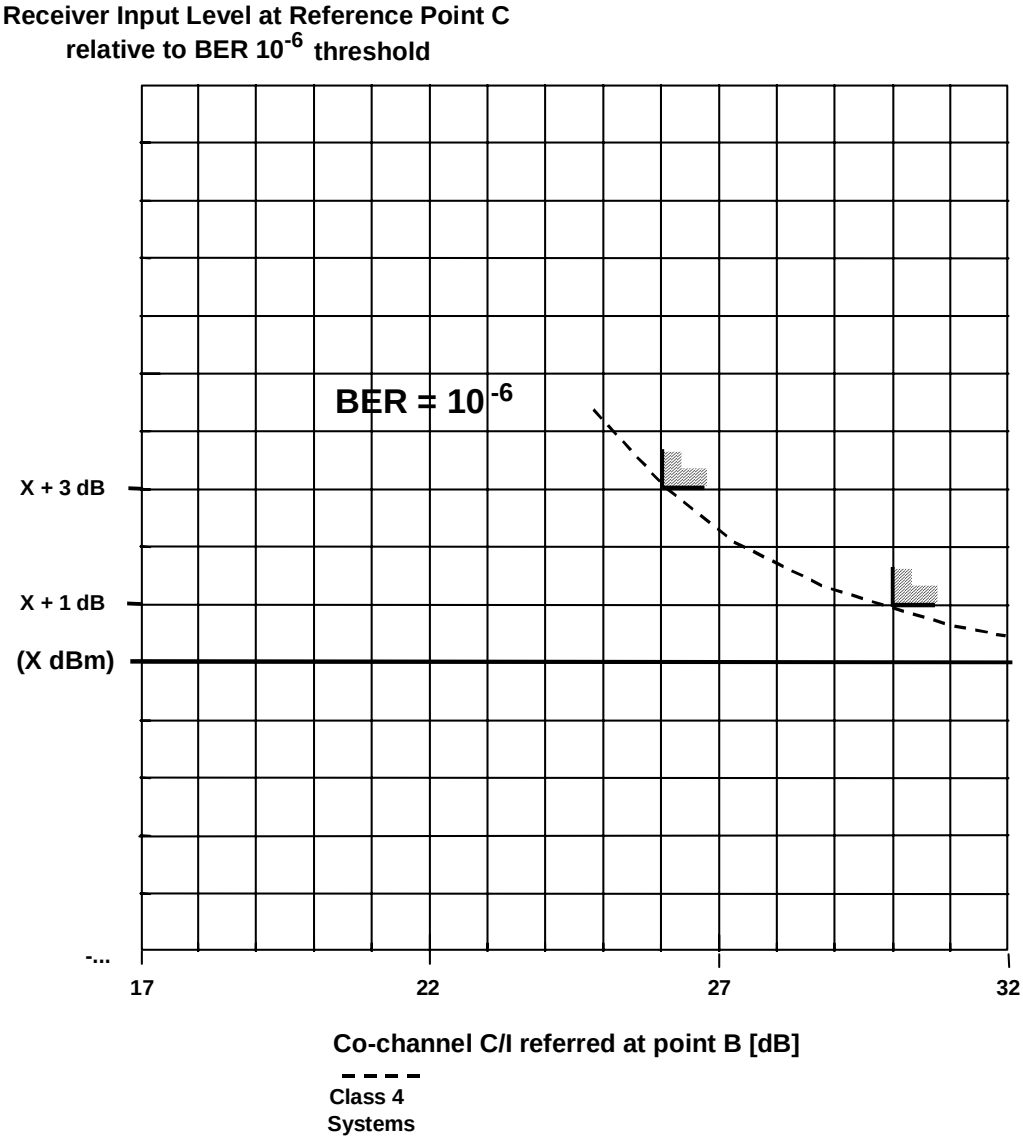
Another option is to ensure that no errors occur during the minimum recording time shown in table A.1.

Table A.1: Zero errors recording times

Bit-rate under test [Mbit/s]	Minimum recording time [minutes]	errors
2	82	0

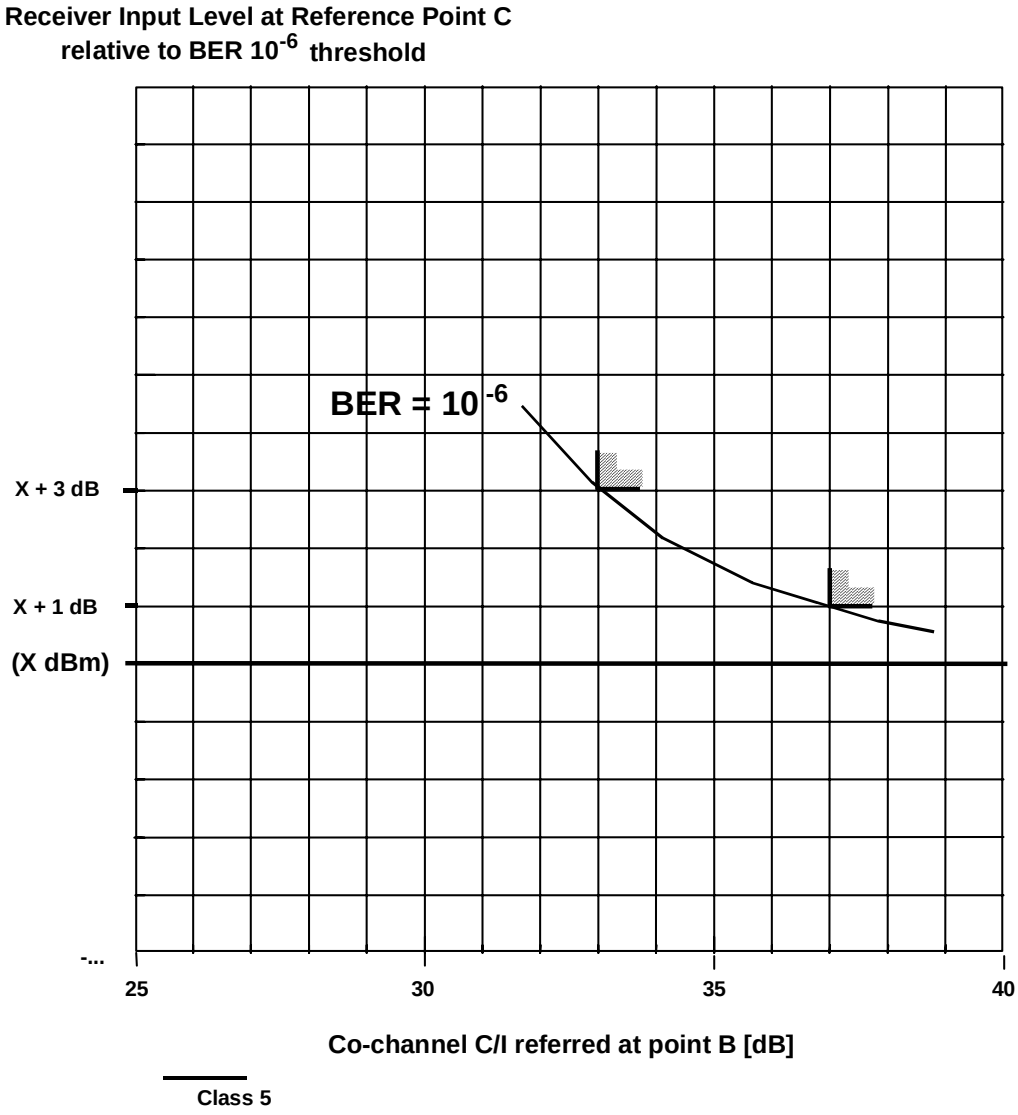
A.4 Co-channel and adjacent channel interference

The performances for co-channel and adjacent channel spaced by one channel spacing C/I are reported in clauses 5.5.3.1 and 5.5.3.2 respectively, for 1 dB and 3 dB degradation only; figures A.4.1 and A.4.2 give the indicative behaviour for other values of degradation. The values represented should not be used for frequency co-ordination purposes.



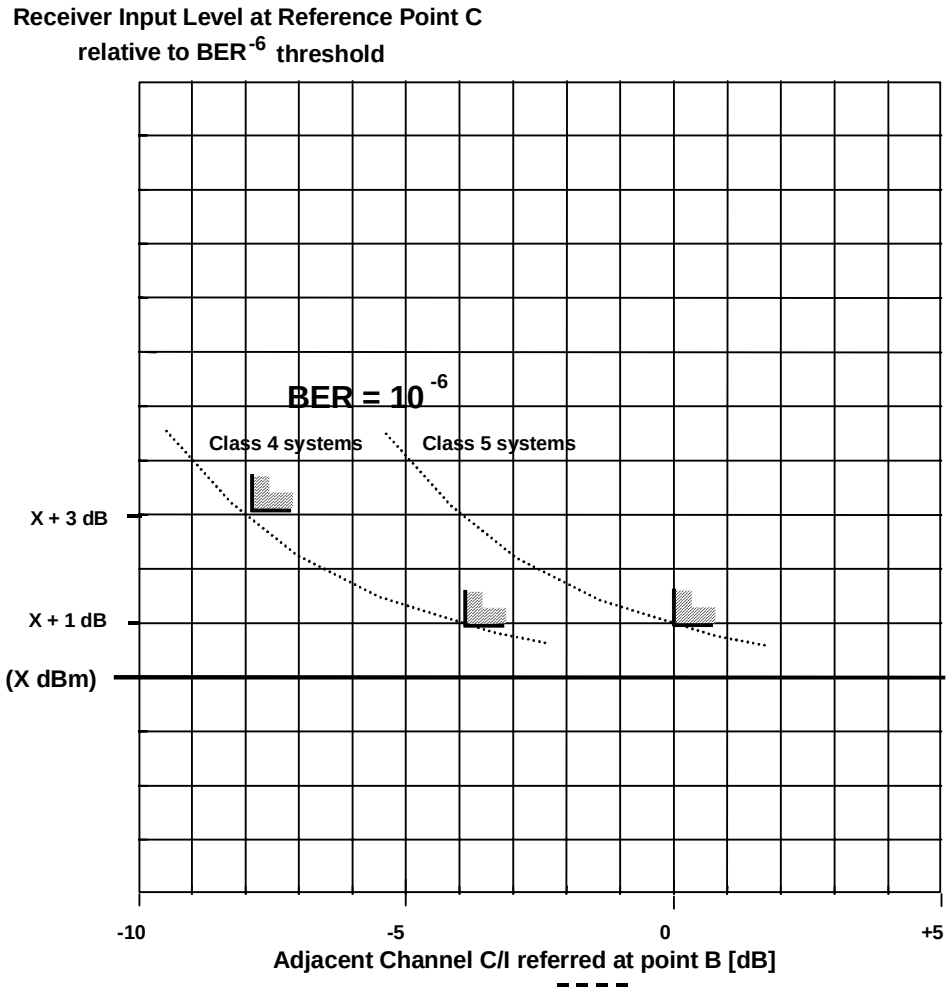
NOTE: X dBm = 10^{-6} BER threshold provided by clause 5.5.1.

Figure A.4.1a: Co-channel interference threshold degradation



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

Figure A.4.1b: Co-channel interference threshold degradation



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

Figure A.4.2: First adjacent channel interference threshold degradation

Annex B (normative): System type codes for regulatory procedures

System types reported in the present document shall be identified with the codes reported in table B.1.

Table B.1: System type codes for radio equipments reported in the present document, relevant to regulatory procedures for national licensing

Spectrum efficiency class ↓	Channel spacing [MHz] ↓	Bit-rate [Mbit/s] ↓	Frequency band ↓	System type codes ↓
4	3,5	sSTM-14	B1	1
5	3,5	sSTM-22	B1	2

Annex C (informative): Bibliography

- ITU-T Recommendation G.773 (1993): "Protocol suites for Q-interfaces for management of transmission systems".
- ITU-R Recommendation F.746: "Radio-frequency channel arrangements for radio-relays systems".
- DTS/TM-4079: "Transmission and Multiplexing (TM); Digital Radio Relay Systems (DRSS); Radio specific SDH functionalities for transmission of sub-STM-0".

History

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