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**Transmission and Multiplexing (TM);
High capacity digital radio-relay systems carrying 1 x STM-1
signals and operating in frequency bands with about 30 MHz
channel spacing and alternated arrangements**

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Foreword

This European Telecommunication Standard (ETS) has been produced by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS contains the minimum technical requirements to ensure compatibility of products and conformance with radio regulations across ETSI member states. Radio terminals from different manufacturers are not required to interwork at radio frequency (i.e. no common air interface). However, terminals may be combined with other manufacturers equipment on an Radio Frequency (RF) branching network for operation on different polarizations.

This ETS defines the requirements of radio terminal and radio relay equipment and associated interfaces. The requirements for multiplex, network management and antenna/feeder equipment may be addressed elsewhere.

Proposed transposition dates	
Date of latest announcement of this ETS (doa):	31 October 1995
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	30 April 1996
Date of withdrawal of any conflicting National Standard (dow):	30 April 1996

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1 Scope

This European Telecommunication Standard (ETS) specifies parameters for digital radio-relay systems with a channel capacity of 1 x Synchronous Transport Module-level 1 (1 x STM-1) designed to operate in defined bands up to 15 GHz utilising approximately 30 MHz between adjacent cross-polar channels.

The parameters specified fall into two categories:

- a) those 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. This category also includes parameters providing compatibility with the existing radio-relay network;
- b) parameters defining the transmission quality of the proposed systems.

The task of defining compatibility requirements with analogue and digital systems on the same hop and at nodes is made complex by the fact that analogue systems and some digital systems are not standardized. Compatibility requirements are, therefore, limited to allowing the operation of digital and analogue channels on separate ports of the same antenna.

The standardization includes the following specifications:

- transmitter and receiver characteristics;
- baseband and Radio Frequency (RF) interface characteristics;
- diversity system characteristics.

Two possible baseband interfaces have to be considered:

- one for STM-1 signals (electrical and/or optical) in accordance with ITU-R Recommendation 750; and
- one for 140 Mbit/s plesiochronous signals (only electrical), according to ITU-T recommendation G.703.

The 140 Mbit/s signals should be carried "open-port", i.e. in a transparent manner independent of their content. They should be mapped into a 155 Mbit/s STM-1 signal as described in ITU-T Recommendations G.708 and G.709.

As regards the STM-1 signal the Section Overhead (SOH) processing is covered in a separate ETSI STC TM 4 document (a report on Synchronous Digital Hierarchy (SDH) aspects) and in ITU-R Recommendation 750 [7].

2 Normative references

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

- [1] ITU-R Recommendation 382: "Radio-frequency channel arrangements for medium and high capacity analogue radio-relay systems operating in the 2 and 4 GHz bands, or for medium and high capacity digital radio-relay systems operating in the 4 GHz band".
- [2] ITU-R Recommendation 385: "Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band".
- [3] ITU-R Recommendation 383: "Radio-frequency channel arrangements for radio-relay systems operating in the Lower 6 GHz band".
- [4] ITU-R Recommendation 386, Annex I: "Description of the radio-frequency channel arrangement referred to in recommends 7".
- [5] ITU-R Recommendation 497: "Radio-frequency channel arrangements for low and medium capacity analogue or medium and high capacity digital radio-relay systems operating in the 13 GHz band".
- [6] ITU-R Recommendation 636: "Radio-frequency channel arrangements for radio-relay systems operating in the 15 GHz band".
- [7] ITU-R Recommendation 750: "Architectures and functional aspects of radio-relay systems for SDH-based networks".
- [8] ITU-R Recommendation 751: "Transmission characteristics and performance requirements of radio-relay systems for SDH-based networks".
- [9] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [10] ETS 300 132: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment".
- [11] CEPT Recommendation T/L 04-04: "Harmonization of 140 Mbit/s digital radio relay systems for operation below 10 GHz utilising 64 QAM at about 30 MHz spacing".
- [12] ITU-T Recommendation G.708 (1990): "Network Node Interface for the Synchronous Digital Hierarchy".
- [13] ITU-T Recommendation G.709 (1990): "Synchronous Multiplexing Structure".
- [14] ITU-T Recommendation G.773: "Protocol Suites for Q-Interfaces for Management of Transmission Systems".
- [15] ITU-T Recommendation G.784: "Synchronous Digital Hierarchy Management".

3 Abbreviations and symbols

3.1 Abbreviations

For the purpose of this ETS the following abbreviations apply.

ATPC	Automatic Transmit Power Control
BER	Bit Error Ratio
DRRS	Digital Radio-Relay System
IF	Intermediate Frequency
L6	Lower 6 (GHz band)
PRBS	Pseudo-Random Binary Sequence
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
Rx	Receive (Receiver)
SDH	Synchronous Digital Hierarchy
SOH	Section Overhead
STM-1	Synchronous Transport Module-level 1
TMN	Telecommunications Management Network
Tx	Transmit (Transmitter)
VSWR	Voltage Standing Wave Ratio
XPD	Cross-Polar Discrimination

3.2 Symbols

For the purpose of this ETS the following symbols apply:

dB	decibel
dBm	decibel relative to 1 mW
GHz	GigaHertz
km	kilometre
m/s	metres per second
Mbit/s	Megabit per second
MHz	MegaHertz
ns	nanosecond
ppm	parts per million
W/m ²	Watts per square metre

4 Network and system considerations

The area of application of these digital radio-relay systems is foreseen to be in regional and trunk networks. Consideration shall be given to the special requirement in the case of a regional network, e.g. simpler towers with less space for antenna, different network structures with high density nodes. Application may also be envisaged for local links and unidirectional connections.

Systems considered in this ETS should be able to respect ITU-R high grade performance objectives.

The systems considered should operate in these networks having regard for existing hop lengths, which are considered to be normally up to about 30 km - 40 km for regional and about 60 km for trunk networks, respectively. Hop lengths greater than this latter length, up to about 100 km, are used in special applications.

5 General characteristics

5.1 Frequency bands and channel arrangements

The systems shall be required to operate in the following frequency bands, to the specified ITU-R Recommendation on the quoted channel spacings.

4 GHz

ITU-R Recommendation 382 [1] with 29 MHz channel spacing. The centre gap between transmitters and receivers in ITU-R Recommendation 382 [1] is 68 MHz.

Lower 6 GHz

ITU-R Recommendation 383 [3] with 29,65 MHz spacing and a centre gap of 44,49 MHz. The alternative plan in which channels 8 and 1' operate on opposite polarizations should be utilised.

7 GHz

A number of frequency channelling plans are in use at 7 GHz, including that given in ITU-R Recommendation 385 [2] Annex III. These plans all make use of 28 MHz channel spacing with centre gaps of 56 MHz or 84 MHz.

8 GHz

ITU-R Recommendation 386 [4], Annex 1, with 29,650 MHz spacing and a centre gap of 103,770 MHz.

13 GHz

ITU-R Recommendation 497 [5] with 28 MHz spacing and a centre gap of 70 MHz.

15 GHz

ITU-R Recommendation 636 [6] with 28 MHz spacing. The centre gap shall be equal to $N \times 28$ MHz (N integer) and greater than 84 MHz.

5.2 Modes of operation

The mode of operation shall make use of alternate polarizations for adjacent channels in all frequency bands up to 15 GHz (covered by this ETS).

It should be noted that systems designed for co-frequency cross-polar operation with a 30 MHz channel spacing are also expected to comply at least with the specifications contained in this ETS.

However, more stringent specifications for spectrum masks and interference sensitivity would certainly be required for co-frequency cross-polar operation.

5.3 Types of installation

For frequency bands below 10 GHz mainly indoor installations are foreseen.

For radio-relay systems operating in the 13 GHz and 15 GHz bands both indoor and partially outdoor installations are foreseen.

5.3.1 Environmental conditions

The equipment shall be required to meet either the environmental conditions set out in ETS 300 019-1-3 [9] and ETS 300 019-1-4 [9], which define weatherprotected and non-weatherprotected locations, classes and test severities, or one of the conditions listed in subclause 5.3.1.2.

5.3.1.1 Equipment within weatherprotected locations

The most important climatic parameters for the five classes defined are given in table 1.

Table 1

Climatic class	3.1	3.2	3.3	3.4	3.5
High air temperature (°C)	+40	+45	+55	+70	+40
Low air temperature (°C)	+5	-5	-25	-40	-40
High relative humidity (%)	85	95	100	100	100
Low relative humidity (%)	5	5	10	10	10
Air movement (m/s)	5	5	5	5	5
Solar radiation (W/m ²)	700	700	1 120	1 120	-

For equipment designed for stationary use in weatherprotected locations (indoor installation), only classes 3.1 or 3.2 shall apply (see ETS 300 019-1-3 [9]).

5.3.1.2 Equipment for non-weatherprotected locations

This type of equipment is generally described as "outdoor" equipment. Class 4.1 or extended class 4.1E parameters should be applied. Class 4.1 applies to many ETSI countries and class 4.1E applies to them all. The most important parameters values are given in table 2.

Table 2

Climatic class	4.1	4.1E
High air temperature (°C)	+40	+45
Low air temperature (°C)	-33	-45
High relative humidity (%)	100	100
Low relative humidity (%)	15	8
Air movement (m/s)	+50	+50
Solar radiation (W/m ²)	1 120	1 120

It should be noted that radio cabinets supplied with a system will give their own "weather protection" including full protection against precipitation and wind. Climatic classes 3.3, 3.4 and 3.5 (subclause 5.3.1.1) may, therefore, also be applicable to equipment in outdoor locations.

The operation of the outdoor equipment in accordance with Class 4.1E shall not be mandatory for all ETSI members.

Some ETSI members may also decide to apply one of the non-standard specifications given in table 3.

Table 3

High air temperature (°C)	+40	+50
Low air temperature (°C)	-20	-30
High relative humidity (%)	90	90
Low relative humidity (%)	5	5
Air movement (m/s)	+50	+50
Solar radiation (W/m ²)	1 120	1 120

5.3.2 Electromagnetic compatibility conditions

Equipment shall operate under the conditions specified in relevant standards produced by the appropriate European standard organizations (under study in ETSI STC RES 9).

For enclosure emissions and immunity to RF electromagnetic fields, the range of frequencies is extended to cover frequencies up to 2 GHz.

5.3.3 Mechanical dimensions

The mechanical dimensions for indoor installations should be in agreement with ETS 300 119.

The following parameters should be taken into account in the design of equipment incorporating an external unit:

- a) maximum weight of the external unit;
- b) size of external unit for wind loading considerations;
- c) maximum weight of replaceable units;
- d) ease of access to replaceable units.

5.3.4 Power supply

The equipment shall operate from any of the supply voltages within the ranges specified in ETS 300 132 [10]. According to ETS 300 132 [10], the normal values and tolerances, as given in table 4, are specified.

Table 4

48 V DC:	- 40,5	- 57,0	V DC
60 V DC	- 50	- 72	V DC
230 V AC	207	253	V AC/50 Hz \pm 2 Hz

For DC systems, the positive pole of the battery shall be earthed.

NOTE: Some countries may require to use a primary supply of 24 V DC or 110 V AC, which is not covered by ETS 300 132 [10].

5.3.5 Safety considerations

Maximum radiated power density under normal operating conditions shall be in accordance with current World Health Organization figures.

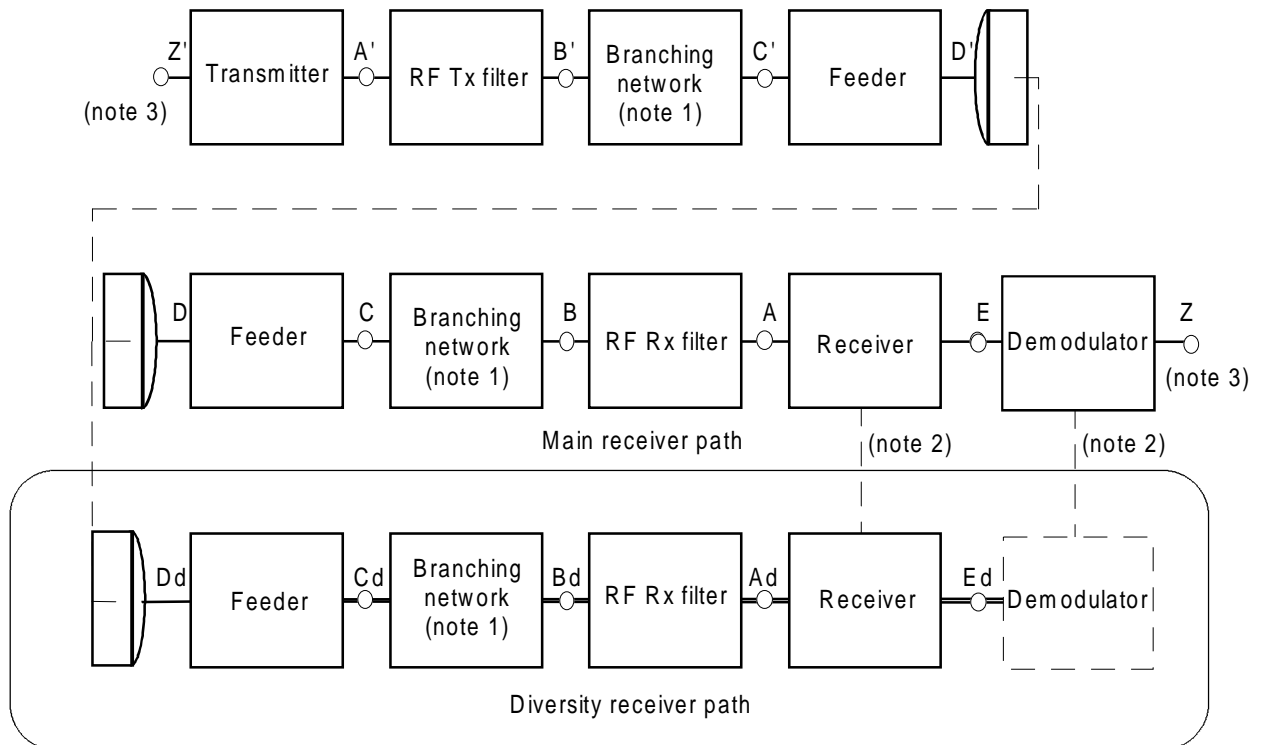
5.4 Telecommunications Management Network (TMN) interface

Where provided, a TMN interface shall follow relevant ITU-T and ITU-R Recommendations and ETSs.

5.5 System block diagram

The system block diagram including reference points is shown in figure 1. These points are reference points only and not necessarily measurement points.

The receiver diversity path shown in the block diagram refers only to combining techniques.



NOTE 1: No filtering included.

NOTE 2: Connection at RF, IF or baseband.

NOTE 3: A 155 Mbit/s or 140 Mbit/s interface is used at points Z and Z'.

Figure 1: Block diagram

5.6 Intermediate Frequency (IF)

If any, the IF should preferably be 70 MHz.

5.7 Local oscillator arrangements

When an IF is used, the local oscillator frequencies for both, transmitters and receivers, shall be in the same half-band as their associated transmitter or receiver carrier frequencies.

6 Transmitter characteristics

6.1 Output power

Referred to point B' the value of the output power shall be less or equal to +38 dBm and greater or equal to +20 dBm, all tolerances included.

Depending on environmental conditions (see subclause 5.3.1) the nominal output power tolerance should be within:

- +1 dB/-1 dB for the classes 3.1 and 3.2;
- +2 dB/-1 dB for all other classes.

NOTE: For the purpose of system engineering four classes of nominal output power are defined (see intervals in table 5).

Equipments of different output power classes are not considered to require individual type approval, however this is subject to individual national agreements.

Table 5

Class A		< + 26 dBm
Class B	≥ + 26 dBm	< + 31 dBm
Class C	≥ + 29 dBm	< + 34 dBm
Class D	≥ + 34 dBm	

In the case of a 140 Mbit/s transport signal, the measurement shall be carried out with the carrier modulated by a pseudo-random bit sequence $2^{23}-1$.

In the case of a STM-1 signal the measurement shall be carried out using an STM-1 test signal to be defined.

6.2 Automatic Transmit Power Control (ATPC)

ATPC is an optional feature, information on ATPC is given in an informative annex (see annex A, clause A.2).

6.3 RF spectrum masks

The three main factors considered in recommending a mask are as follows:

- a) control of interference into analogue channels operating on the adjacent channel allocation on the orthogonal polarization;
- b) control of interference into digital channels from a different manufacturer's equipment operating on the adjacent channel allocation on the orthogonal polarization;
- c) different transmitter characteristics.

The spectrum mask given in figure 2 for all frequency bands considered is based on a level of compatibility required, which is identical to that considered in CEPT Recommendation T/L 04-04 [11]. It allows compatibility between systems defined in this ETS and those specified in the CEPT Recommendation.

If, depending on application, administrations or operating companies do not require compatibility with systems specified in CEPT Recommendation T/L 04-04 [11], a slightly relaxed spectrum mask as given in figure 2 curve c), may be applied. However, all other specifications in this ETS shall be met.

The spectrum mask marked (a) in figure 2 shall be verified directly by measurement (referenced to point B'). Since it is not possible to measure attenuation values up to 105 dB directly, values of the relative power spectral density below -65 dB in figure 2 (curve (b)) and figures 3 and 4 should be verified by adding a measured filter characteristic to the spectrum at A'.

Masks shall be measured with a modulating baseband signal, given by a Pseudo-Random Binary Sequence (PRBS) $2^{23}-1$ in the case of a 140 Mbit/s signal, or an STM-1 test signal to be defined.

The spectrum masks are referenced to the level at the centre of the spectrum excluding any residual carrier and to the actual carrier frequency; they shall be verified for the actual output power. The frequency tolerance is not included in the masks.

The spectrum analyser settings for measuring the RF spectrum masks are given below in table 6.

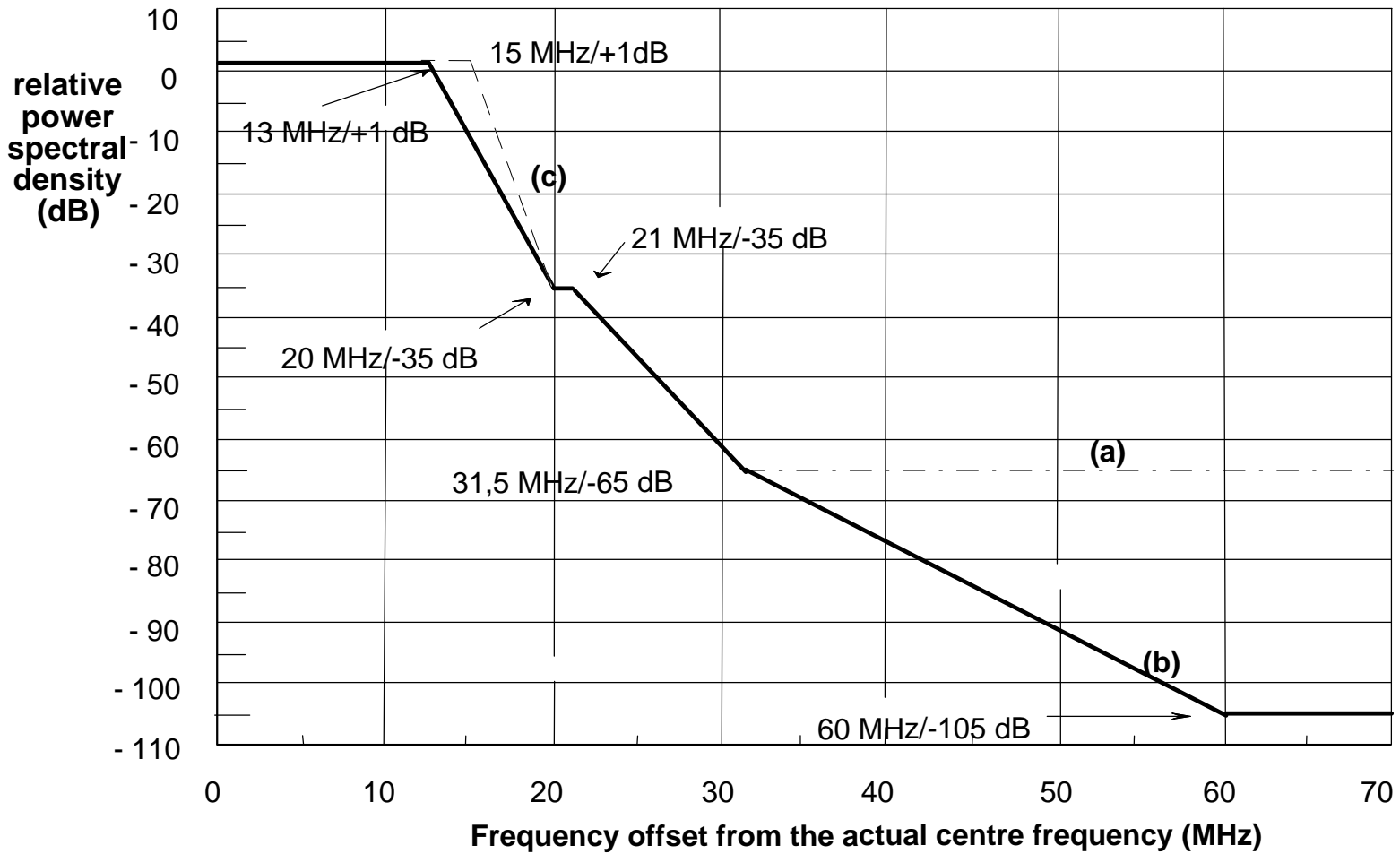
Table 6

Parameter	Setting
IF bandwidth	100 kHz
Total sweep width	200 MHz
Total scan time	20 s
Video filter bandwidth	0,3 kHz

For the Lower 6 (L6) GHz band, where the centre gap (44,49 MHz) is particularly small, a mask is specified for the innermost edges of the centre gap channels 8 and 1' (referenced to point B'), the mask is given in figure 3.

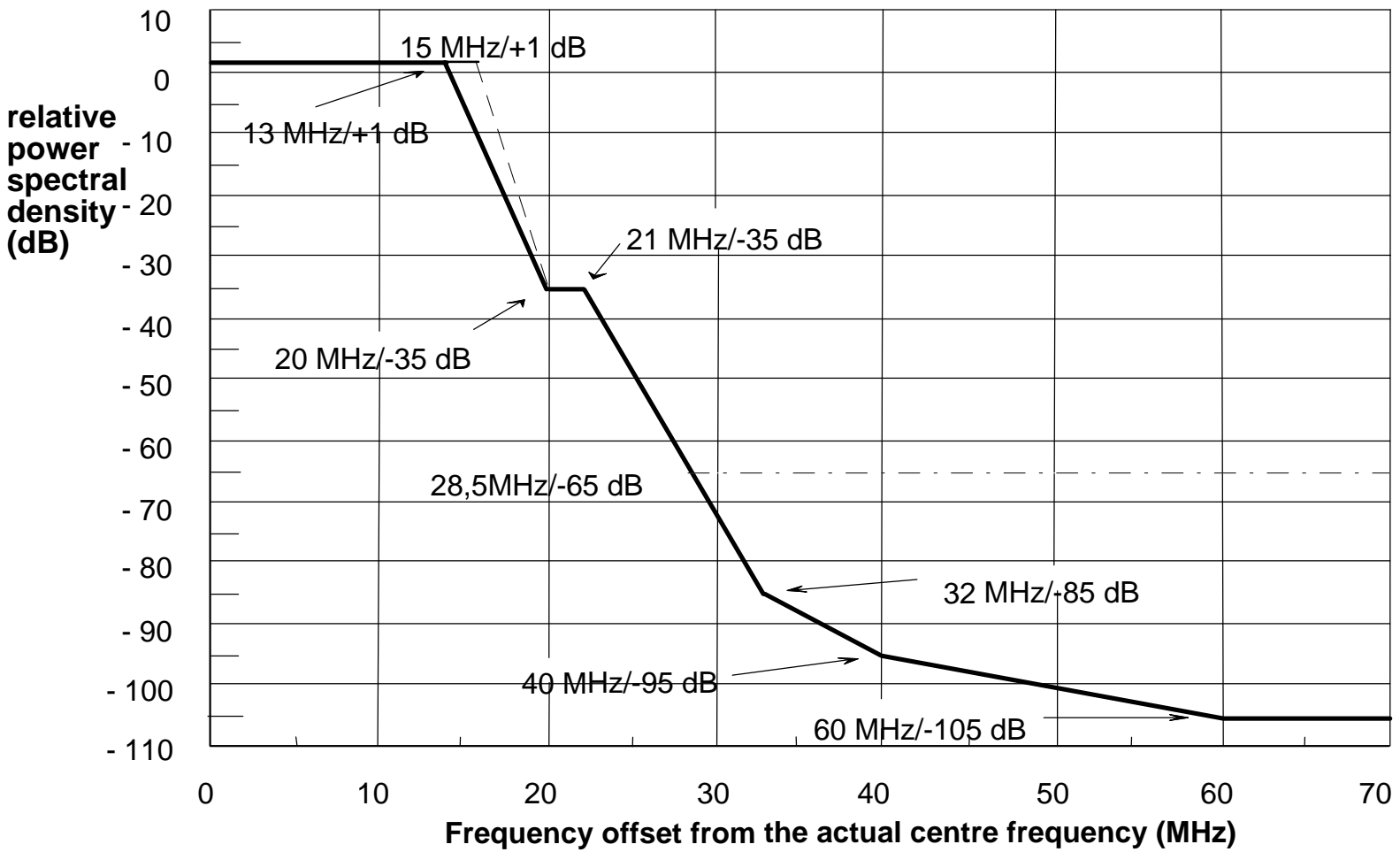
A mask for the innermost channels in the 7 GHz band (centre gap 56 MHz) is given in figure 4.

The mask labelled (b) in figure 2 fixes a lower limit of - 105 dB in order to control local interference between transmitters and receivers as for the innermost channels.



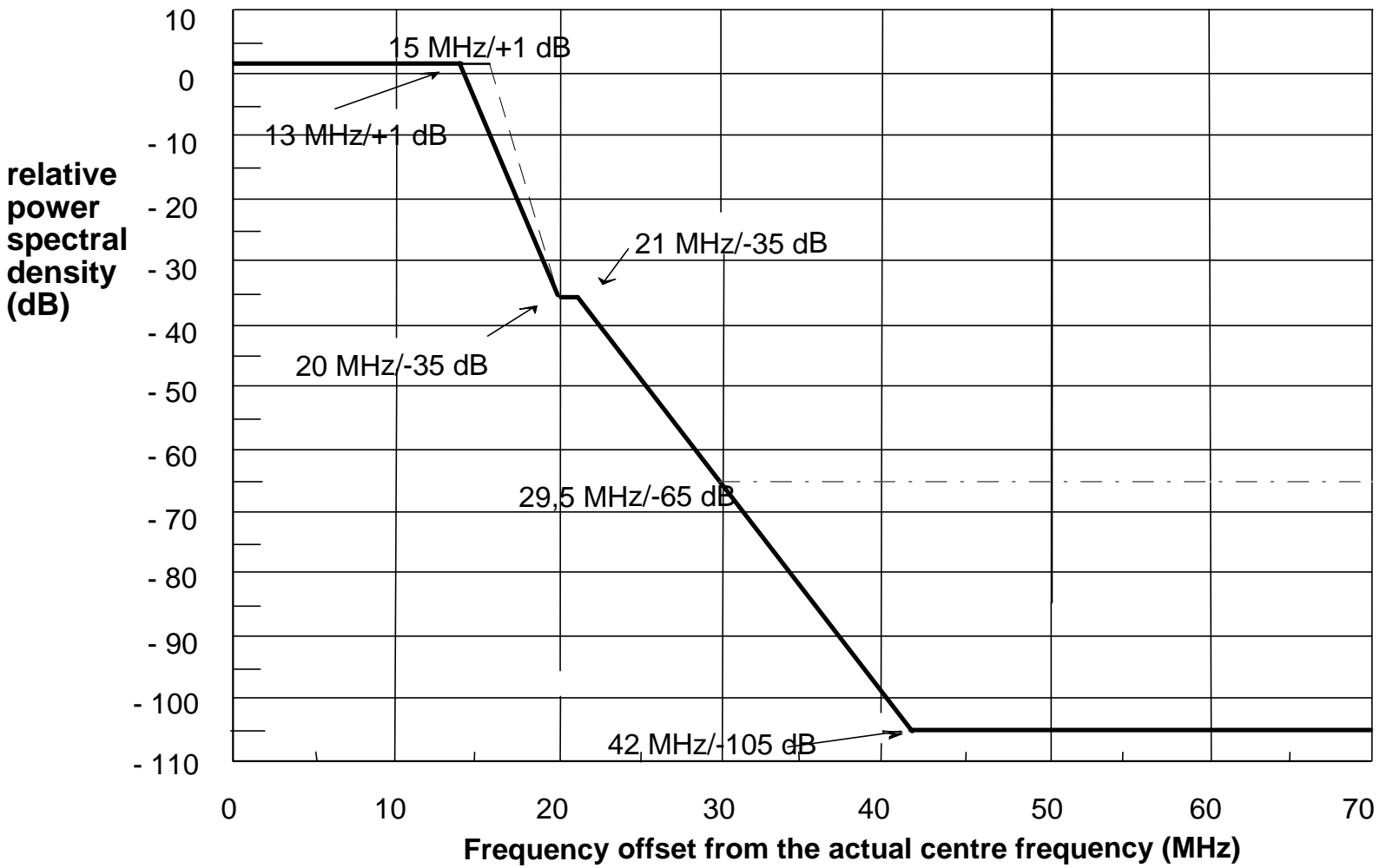
NOTE: Frequency tolerance not included in the mask.

Figure 2: Limits of spectral power density for normal channels (reference point B')



NOTE: Frequency tolerance not included in the mask.

Figure 3: Limits of spectral power density for the inner edges of innermost channels, L6 GHz band (reference point B')



NOTE: Frequency tolerance not included in the mask.

Figure 4: Limits of spectral power density for the inner edges of innermost channels in the 7 GHz band with 56 MHz centre gap (reference point B')

6.4 Spectral lines at the symbol rate

To facilitate sharing with analogue systems the power level of spectral lines at a distance from the channel centre frequency equal to the symbol rate shall be less than or equal to - 37 dBm.

6.5 Spurious emissions

Spurious emissions are defined as 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, intermodulation products and frequency conversion products, but exclude emissions which result from the modulation process. The necessary bandwidth is defined as twice the transmitted symbol rate.

Spurious emission limits from transmitters shall be defined for two reasons:

- a) to limit interference into systems operating wholly externally to the STM-1 system channel plan;
- b) to limit local interference within the STM-1 system where transmitters and receivers are directly connected via the filter and branching systems.

This leads to two sets of spurious emission limits where the specific limits given for "internal" interference shall be no greater than the "external" level limits at point B' for indoor systems and C' for outdoor systems where a common Transmit/Receive (Tx/Rx) duplexer is used.

6.5.1 Spurious emissions - external

The frequency range in which the spurious emission specifications apply is 30 MHz to 40 GHz (covering the limit of 2nd harmonic of highest frequency in 15 GHz band). The limit values referenced to at point C' are:

30 MHz to 21,2 GHz ≤ - 60 dBm;
21,2 GHz to 40,0 GHz ≤ - 30 dBm.

NOTE: These values are provisional; final values are subject to consultation with CEPT and other relevant parties.

6.5.2 Spurious emissions - internal

The levels of the spurious emissions from the transmitter, referenced to point B' are specified as follows (table 7). They correspond to the values defined in CEPT Recommendation T/L 04-04 [11] for 140 Mbit/s-64 Quadrature Amplitude Modulation (QAM) systems.

Table 7

Spurious emission frequency relative to channel assigned frequency	Specification limit	Controlling factor
± IF (local oscillator frequency)	≤ - 60 dBm	Within half-band digital into analogue
± 2 x IF (unwanted sideband)	≤ - 90 dBm	Other half-band digital into digital
± IF, ± 3 x IF (unwanted sideband at 2nd IF harmonic)	≤ - 90 dBm	Other half-band digital into digital

The levels of all other spurious signals shall be:

≤ - 90 dBm If spurious signal frequency falls within receiver half-band;
≤ - 60 dBm If spurious signal frequency falls within transmitter half-band.

For digital systems without branching network (i.e. with duplexer) the - 90 dBm limits for the spurious signals as given above shall be relaxed to:

≤ - 70 dBm.

6.6 Radio frequency tolerance

Maximum radio frequency tolerance shall not exceed ± 30 ppm for all frequency bands considered. This limit includes both short-term factors (environmental effects) and long-term ageing effects.

6.7 Return loss

Minimum return loss shall be 26 dB at point C' over the full RF band and measured back in the direction to the transmitter.

7 Receiver characteristics

7.1 Receiver image rejection

For the frequency bands below 10 GHz the receiver image rejection shall be the same as that given in CEPT Recommendation T/L 04-04 [11], that is:

- ≥ 120 dB at 4 GHz and 7 GHz bands;
- ≥ 100 dB at L6 GHz and 8 GHz bands.

For the 13 GHz and 15 GHz bands the limit shall be:

- ≥ 90 dB.

7.2 Spurious emissions

Spurious emissions are defined as 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, intermodulation products and frequency conversion products, but exclude emissions which result from the modulation process. The necessary bandwidth is defined as twice the transmitted symbol rate.

Spurious emissions from receivers shall be defined for two reasons:

- a) to limit interference into systems operating wholly externally to the STM-1 system channel plan;
- b) to limit local interference within the STM-1 system where transmitters and receivers are directly connected via the filter and branching systems.

This leads to two sets of spurious emission limits where the specific limits given for "internal" interference shall be no greater than the "external" level limits at point B for indoor systems and C for outdoor systems where a common Tx/Rx duplexer is used.

7.2.1 Spurious emissions - external

The frequency range in which the spurious emission specifications apply is 30 MHz to 40 GHz (covering the limit of 2nd harmonic of highest frequency in 15 GHz band). The limit values measured at point C are:

- 30 MHz to 21,2 GHz $\leq - 60$ dBm;
- 21,2 GHz to 40,0 GHz $\leq - 30$ dBm.

NOTE: These values are provisional; final values are subject to consultation with CEPT and other relevant parties.

7.2.2 Spurious emissions - internal

For spurious emissions at the local oscillator frequency provisional limits of $\leq - 125$ dBm for the 7 GHz band and $< - 110$ dBm for all other bands shall apply (referenced to point B).

7.3 Input level range

The lower limit for the receiver input level shall be given by the threshold level for Bit Error Ratio (BER) = 10^{-3} . The upper limit for the receiver input level, where a BER of 10^{-3} is not exceeded shall be -17 dBm; a BER of 10^{-10} may only be exceeded for levels greater than -21 dBm. These limits apply without interference and are referenced to point B.

NOTE: When ATPC is used the maximum input level for BER < 10^{-10} may be relaxed to -30 dBm.

7.4 Overall receiver selectivity for the L6 GHz innermost channels

In order to control transmit/receive interference between the innermost channels of the band, an additional spectrum mask for the inner edge of the transmitters operating in this part of the band was defined in figure 3. In addition an overall receiver selectivity mask has to be specified.

Figure 5 specifies the mask for the overall relative receiver selectivity for the inner edges of the innermost L6 GHz channels. The receiver selectivity may be evaluated by calculating the effect of all receiver filters (RF, IF, baseband) on the received signal.

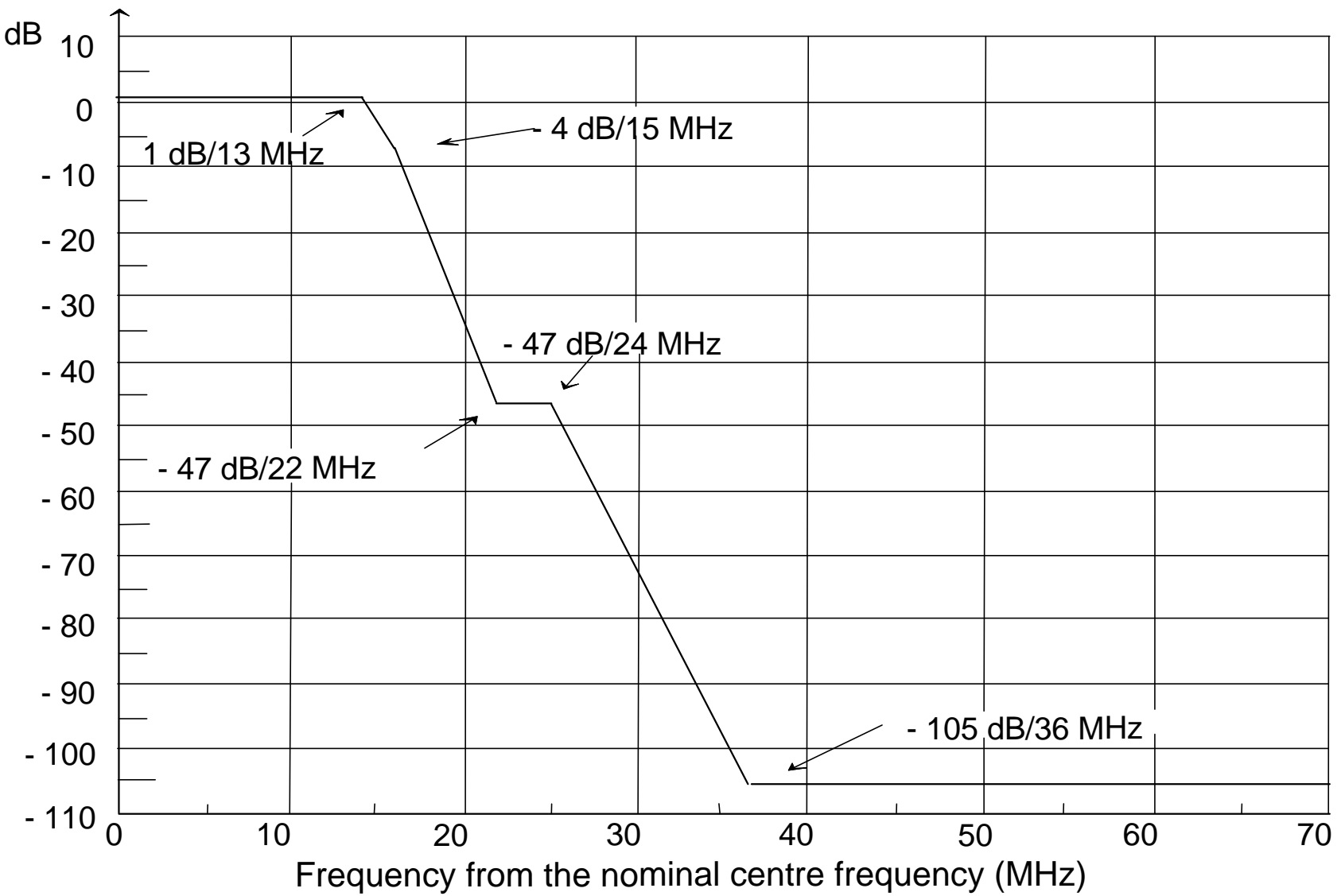


Figure 5: Limits for the inner edges of relative receiver selectivity for innermost channels, L6 GHz band

7.5 Return loss

Minimum return loss measured at point C shall be 26 dB over the full RF band and measured in the direction to the receiver.

8 System characteristics without diversity

8.1 Equipment background BER

Equipment background BER is measured under simulated operating conditions over an artificial hop without interference with a signal level at point B which is between 15 dB and 40 dB above the lower level which gives $BER = 10^{-3}$.

In a measurement period of 24 hours the number of bit errors shall be less than 10 ($BER \leq 10^{-12}$).

8.2 BER as a function of receiver input level

The reference point for the definition of the BER curve as a function of receiver input level is point B.

The BER values shall be less or equal to the values given in table 8 for the corresponding signal levels and frequency bands.

Table 8

	Frequency band		
	< 10 GHz	13 GHz	15 GHz
BER $\leq 10^{-3}$	- 71,0 dBm	- 70,0 dBm	- 69,5 dBm
BER $\leq 10^{-6}$	- 67,0 dBm	- 66,0 dBm	- 65,5 dBm
BER $\leq 10^{-10}$	- 63,0 dBm	- 62,0 dBm	- 61,5 dBm

8.3 Interference sensitivity

Interference sensitivity characteristics specified in this ETS are based on those defined in CEPT Recommendation T/L 04-04 [11] for 140 Mbit/s 64 QAM systems and take into account improvement of receiver threshold characteristics.

8.3.1 Co-channel interference sensitivity

For the frequency bands as given in subclause 5.1, the limits of the co-channel interference sensitivity shall be as given in figure 6.

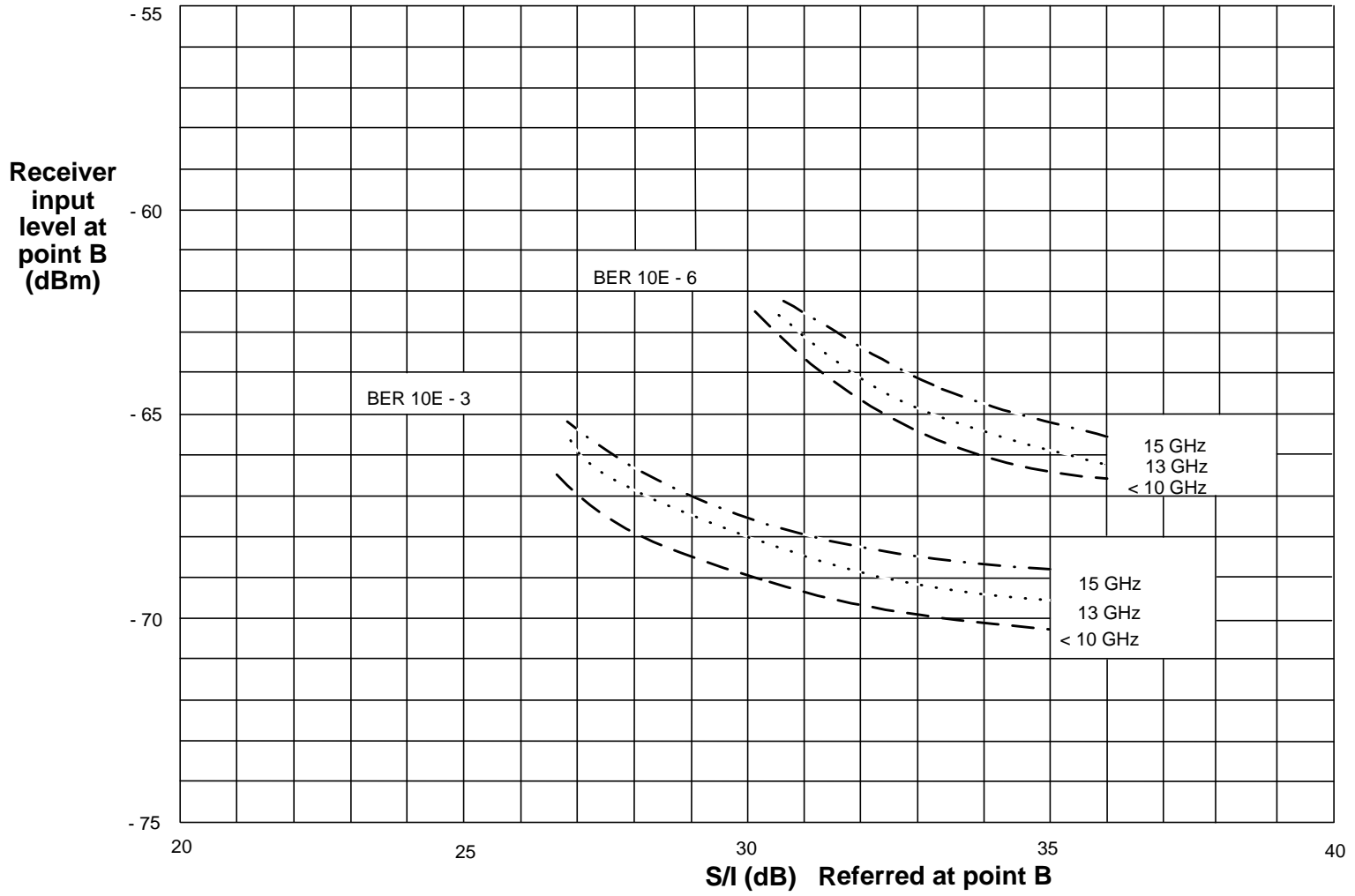


Figure 6: Co-channel digital interference sensitivity limits

8.3.2 Adjacent channel interference sensitivity

The BER shall be less or equal to the values indicated in table 9 for the corresponding receiver input levels, S/I levels and frequency bands. All levels are referenced to point B.

Table 9

		Frequency bands			
		4/L6 GHz/8 GHz	7 GHz	13 GHz	15 GHz
BER $\leq 10^{-3}$	S/I	3 dB	7 dB	7 dB	7 dB
	Receiver input level	- 67,5 dBm	- 67,5 dBm	- 66,5 dBm	- 66 dBm
BER $\leq 10^{-6}$	S/I	7 dB	11 dB	11 dB	11 dB
	Receiver input level	- 65 dBm	- 65 dBm	- 64 dBm	- 63,5 dBm

8.3.3 CW Spurious Interference

Under study.

8.4 Distortion sensitivity

For a delay of 6,3 ns and a BER of 10^{-3} the width of the signature shall not exceed ± 17 MHz relative to the channel assigned frequency and the depth shall not be less than 14 dB.

For a delay of 6,3 ns and a BER of 10^{-6} the width of the signature shall not exceed ± 20 MHz relative to the channel assigned frequency and the depth shall not be less than 11 dB.

These limits are valid for both minimum and non-minimum phase cases.

The limits specified for BER = 10^{-3} shall also be verified by the loss-of-synchronization and re-acquisition signatures.

9 System characteristics with diversity

Space-, angle- and frequency-diversity techniques are applicable. In this clause only combining techniques are considered.

9.1 Differential delay compensation

It shall be possible to compensate for differential absolute delays due to antennas, feeders and cable connections on the two diversity paths. The range of adjustment shall be at least 75 ns of differential absolute delay.

9.2 BER performance

When both receiver inputs (main and diversity, points B and B_D) are fed with low level input signals of the same level at an arbitrary phase difference, input level limits for specified BER values shall be:

- for IF or baseband combining systems, 2,5 dB below those given in subclause 8.2 for the case without diversity;
- for RF combining systems, 1,5 dB below those given in subclause 8.2 for the case without diversity.

Annex A (informative): Branching/feeder/antenna requirements

The parameters and values specified in this annex are essential prerequisites for the system specification given in this ETS.

A.1 Cross-Polar Discrimination (XPD)

The measured effective XPD over a typical hop (50 km at frequencies below 10 GHz, 25 km at 13 GHz and 18 km at 15 GHz) under no-fading conditions shall not be less than 28 dB.

A.1.1 Intermodulation products

Each intermodulation product caused by different transmitters linked at point C' to a measurement test set with a return loss higher than 23 dB is assumed to be less than - 110 dBm referenced to point B' with an output power of about 28 dBm per transmitter.

A.1.2 Interport isolation

This shall not be less than 40 dB.

A.1.3 Return loss

This shall not be less than 26 dB (Voltage Standing Wave Ratio (VSWR) = 1,10:1) at the antenna flange (points D, D').

A.2 ATPC

ATPC can be useful in many circumstances, especially:

- to improve analogue-digital compatibility in the case of antennas with poor cross-polarization discrimination performance or in the case of high nominal output power for the Digital Radio Relay Systems (DRRS);
- to reduce digital to digital distant interference between hops which re-use the same frequency;
- to improve compatibility with both digital and analogue systems at nodal stations;
- to reduce the effects of up-fading propagation conditions on the system.

ATPC is an optional feature which is aimed at driving the Tx power amplifier output level from a proper minimum which is calculated to facilitate the radio network planning and which is used in the case of normal propagation up to a maximum value which is defined by the relative class of output power and the complete fulfilment of all the specifications defined in this ETS.

The ATPC range is the power interval from the nominal output power level to the lowest power amplifier output level (at point B') with ATPC.

The ATPC range should not exceed 25 dB. When compatibility with analogue systems is required, the lowest power amplifier output level should not be less than + 10 dBm; this may result in a reduced ATPC range.

Annex B (informative): Bibliography

- 1) ETS 300 119: "Equipment Engineering (EE); European telecommunication standard for equipment practice".
- 2) IEC Publication 835-2: "Methods of measurement for equipment used in digital microwave radio transmission systems - Part 2: Measurements on terrestrial radio-relay systems" (sections 4 and 6).

History

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