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Transmission and Multiplexing (TM); Parameters for radio-relay systems for the transmission of digital signals and analogue video signals operating around 55 GHz

ETSI

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Contents

Foreword

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

This ETS specifies the minimum performance parameters for radio equipment operating at frequencies around 55 GHz, as specified in the scope. Other standards cover radiocommunications equipment not listed in Clause 1.

Annex A (Bibliography) provides details of the informative references provided in this ETS.

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1 Scope

This draft European Telecommunication Standard (ETS) covers the minimum performance requirements for terrestrial fixed services radiocommunications equipment, as given below, at frequencies around 55 GHz.

This ETS specifies the performance criteria for the different equipment groups. The equipment groups are:

- digital signals;

- analogue video signals.

2 Normative references

This ETS incorporates by dated and 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] prETS 300 132-1: "Equipment Engineering; Power supply interface at the input to telecommunications equipments Part 1: Interfaces operated by alternating current "AC"" (DE/EE-02001.1).

[2] prETS 300 132-2: "Equipment Engineering; Power supply interface at the input to telecommunications equipments Part 2: Interfaces operated by alternating current "DC"" (DE/EE-02001.2).

[3] ETS 300 019: "Equipment engineering; Environmental conditions and environmental tests for telecommunications equipment".

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

[5] ITU-T Recommendation G.707: "Synchronous digital hierarchy bit rates".

[6] ITU-T Recommendation G.708: "Network node interface for the synchronous digital hierarchy".

[7] ITU-T Recommendation G.709: "Synchronous multiplexing structure".

[8] CCITT Recommendation G.781: "Structure of Recommendations on multiplexing equipment for the synchronous digital hierarchy (SDH)".

[9] CCITT Recommendation G.782: "Types and general characteristics of synchronous digital hierarchy (SDH) multiplexing equipment".

[10] CCITT Recommendation G.783: "Characteristics of synchronous digital hierarchy (SDH) multiplexing equipment functional blocks".

[11] CCITT Recommendation G.784: "Synchronous digital hierarchy (SDH) management".

[12] CCIR Recommendation 403: "Intermediate-frequency characteristics for the interconnection of analogue radio-relay systems".

3 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

BER	Bit Error Ratio
C/I	Carrier/Interface
IF	Intermediate Frequency
FM	Frequency Modulation
ppm	parts per million
PAL	Phase Alternate Line
RF	Radio Frequency
RSL	Receiver Signal Level
SDH	Synchronous Digital Hierarchy
SRL	Spectrum Reference Level

4 General characteristics

4.1 Frequency bands and channel arrangements

4.1.1 Frequency band

The frequency band is 54,25 GHz to 57,2 GHz.

Channel Plan: the channel plan is constructed on a basic raster of 14 MHz.

4.1.2 Co-polar channel spacing

Table 1: Digital systems

Minimum system rate Mbit/s	Maximum channel spacing MHz
2	14
8	28
34	56
140/155	140

Table 2: Analogue systems

Video baseband MHz	< 3,5	< 6	< 10	< 14
Channel spacing MHz	42	70	70	70

4.1.3 Transmit/receive centre gap

The centre gap shall be taken as a multiple of the basic raster distance of 14 MHz, and shall not be less than 140 MHz.

4.1.4 Transmit/receive duplex frequency separation

The transmitter receiver duplex frequency separation shall not be less than 500 MHz. (Typical separations will be around 1 000 MHz).

4.2 Performance prediction and objectives

For medium grade performance the objectives should be to comply with class 4 digital section CCIR Recommendation 696.

For local grade performance reference should be made to CCIR Recommendation 697 and CCIR Report 1053.

The dominant fading mechanism is rain attenuation; performance prediction methods should be based on the following documents:

CCIR Report 338:
CCIR Report 721: } Calculation of rain attenuation and outage

CCIR Report 563: Rain rates.

NOTE: This information should be considered as preliminary.

4.3 Compatibility requirements between systems

In order to provide compatibility between systems:

a) systems should be required to operate on common hops using separate antennas;
b) there should be no requirement to operate transmitting equipment from one manufacturer with receiving equipment from another.

4.4 Types of installation

The equipment may comprise both radio relay units in weather protected locations, and outdoor units with the Radio Frequency (RF) assemblies located close to the antenna in order to minimise feeder losses.

4.4.1 Environmental conditions

The equipment shall be required to meet this ETS for the environmental conditions set out in ETS 300 019 [3], which defines weather protected and outdoor environmental classes and test severities. Small or normal failure consequences shall be assumed.

Because borders of CEPT countries do not follow the climatic zones, modifications have been made to climatic parameters (e.g. air temperature) in order to cover all CEPT countries, but not to include unnecessary extremes.

The environmental conditions applicable to the weather protected and outdoor portions of the equipment need not be the same for all ETSI members.

4.4.1.1 Weather protected equipment

The most important environmental parameter values of the five classes are as given in table 3.

Table 3

	ETS 300 019 [3] enclosed locations		ETS 300 019 [3] protected locations		
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	1120	1120	-

Equipment for the classes 3.1 and 3.2 are most commonly required by ETSI member countries. The operation of radio relay equipment covering all the above classes is not mandatory.

4.4.1.2 Outdoor equipment

For equipment to be used in the entire area covering all ETSI countries class 4.1 E shall apply (see ETS 300 019 [3]) for which the most important environmental parameter values are as follows:

-	high air temperature	+ 45°C
-	low air temperature	- 45°C
-	high relative humidity	100 %
-	low relative humidity	8 %
-	air movement	50 m/s
-	solar radiation	1120 W/m²

The operation of the outdoor equipment in accordance with the class 4.1 is not mandatory for all ETSI members (see ETS 300 019 [3]).

Some ETSI members may decide to apply one of the specifications given below:

-	high air temperature	+ 40°C	+ 50°C
-	low air temperature	- 20°C	- 30°C
-	high relative humidity	90 %	90 %
-	low relative humidity	5 %	5 %
-	air movement	50 m/s	50 m/s
-	solar radiation	1120 W/m²	1120 W/m²

4.4.2 Electromagnetic compatibility

Under study.

4.5 Block diagram

The RF block diagram is shown in figure 1.

4.6 General characteristics

The following characteristics are desirable:

- tuning facilities;
- flexibility for location of systems;
- wayside traffic facilities;
- transmitter identification;
- maintenance facilities;
- performance monitoring facilities.

4.7 TMN interface

A TMN interface required by a user should follow ETSI TM 2 and TM 3 ETSs and CCITT Recommendation G.784 [11] and ITU-T Recommendation G.773.

4.8 Branching/feeder/antenna requirements

a) the antenna radiation pattern envelopes are given in figure 2;

b) antenna flange/equipment feeder flange. When flanges are required, IEC type R620 should be used.

4.9 Mechanical requirements

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

a) maximum weight of external unit;

b) size of external unit for wind loading considerations;

c) maximum weight of replaceable units;

d) ease of access to replaceable units.

4.10 Power supply

The equipment shall operate from any of the primary supplies within the ranges specified in ETS 300 132-1 [1] and ETS 300 132-2 [2].

ETS 300 132-1 [1] and ETS 300 132-2 [2] specify the tolerances as below:

- for 48 V DC nominal: 40,5 to 57 V DC;

- for 60 V DC nominal: 50 to 72 V DC;

- for 230 V AC nominal: 207 to 253 V AC/50 Hz ± 2 Hz.

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

NOTE: Some countries may require the use of a primary supply of 24 V.

4.11 Safety considerations

Maximum radiation power density under normal operating conditions should be in accordance with current World Health Organisation figures.

5 Parameters for digital systems

5.1 Transmission capacity

Bit rates: 2 Mbit/s; 8 Mbit/s; 34 Mbit/s; 140 Mbit/s; and 155 Mbit/s (STM-1).
System rates configured as n x 2 Mbit/s are also considered.

5.2 Applications

2 Mbit/s to 155 Mbit/s point-to-point local and regional networks, mobile base station connections, subscriber access links (including transportable and off-shore use).

5.3 Baseband parameters

5.3.1 2 Mbit/s to 140 Mbit/s baseband interfaces

Table 4: Baseband interfaces for 2 Mbit/s to 140 Mbit/s

	Bit rate (Mbit/s) - plesiochronous			
Parameter	2	8	34	140
Electrical interface	G.703	G.703	G.703	G.703
Service channels (optional)	64 kbit/s	64 kbit/s	64 kbit/s	64 kbit/s
Wayside traffic (optional)	-	-	704 kbit/s or 2,048 Mbit/s	704 kbit/s or 2,048 Mbit/s
G.703: CCITT Recommendation G.703 [4].				

5.3.2 Synchronous Digital Hierarchy (SDH) baseband interface

The SDH baseband interface shall be in accordance with CCITT/ITU-T Recommendations G.703 [4]; G.707 [5]; G.708 [6]; G.709 [7]; G.781 [8]; G.782 [9]; G.783 [10]; G.784 [11]. Under study in ETSI TM 3.

5.4 Transmitter characteristics

5.4.1 Transmitter power range

Maximum output power up to 1 Watt referred to point C' of the RF block diagram given in figure 1.

5.4.2 Transmitter output power tolerance

The output power tolerance shall be within:

±4 dB: classes 3.3 to 3.5 (defined in subclause 4.4.1.1).

all classes defined in subclause 4.4.1.2;

±3 dB: classes 3.1 and 3.2 (defined in subclause 4.4.1.1).

5.4.3 RF spectrum mask

The equipment shall comply with the digital RF power spectrum mask given in figures 3 to 6. The 0 dB Spectrum Reference Level (SRL) shown on the spectrum masks shall be set to the level calculated by the formula in subclause 5.4.3.1.

Due to the modulation process spectrum peaks may reach a value up to 6 dB above the SRL given in figures 3 to 6, between 0 MHz and the first break-point of the mask (shown as a dotted line). All spectrum masks include the allowance for frequency tolerance given in subclause 5.4.5.

NOTE: Spectrum analyzer setting for RF power spectrum measurements:

Bit rate	(Mbit/s)	2	8	34	140
Channel spacing	(MHz)	14	28	56	140
Resolution bandwidth	(kHz)	30	100	100	300
Total sweep width	(MHz)	As appropriate			
Video bandwidth	(kHz)	0,1	0,1	1	1
Recommended scan time	(s)	20	25	2	5

5.4.3.1 SRL formula

The SRL shall be calculated using the following formula:

$$0\ \text{dB SRL} = \text{carrier power} - 10\log_{10}\left(\frac{\text{Symbol rate (Baud)}}{\text{analyser resolution bandwith (Hz)}}\right)\ \text{dBW}$$

5.4.3.2 Residual carrier test

The residual carrier level shall not exceed -10 dB relative to the level of the unmodulated carrier.

5.4.4 Spurious emissions

The transmitter shall be unmodulated, and the level of each spurious emission in the frequency range 1 GHz to 130 GHz, shall not exceed:

≥ 1 GHz and < 21,2 GHz: - 90 dBW

≥ 21,2 GHz and < 80 GHz: - 60 dBW

≥ 80 GHz and ≤ 130 GHz: - 50 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, 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.

NOTE 3: Definitions and methods of measurement for integrated equipment are under study.

NOTE 4: Methods of measurement for the frequency range 80 GHz to 130 GHz are to be agreed with Administrations pending a decision by the IEC.

5.4.5 RF frequency tolerance

RF frequency tolerances are included in the spectrum masks (see figures 3 to 6). The maximum allowable RF frequency tolerance shall not exceed ± 50 ppm.

5.5 Receiver characteristics

5.5.1 Input level range

The input level range for a BER < 10^{-3} shall extend from the upper limit of - 60 dBW to the lower threshold for BER = 10^{-3}, measured at point C.

5.5.2 Spurious emissions

The frequency range in which the spurious emissions specifications apply is 1 GHz to 130 GHz. The limit values measured at point C are:

≥ 1 GHz and < 21,2 GHz: - 90 dBW

≥ 21,2 GHz and < 80 GHz: - 60 dBW

≥ 80 and ≤ 130 GHz: - 50 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, 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.

NOTE 3: Definitions and methods of measurement for integrated equipment are under study.

NOTE 4: Methods of measurement for the frequency range 80 GHz to 130 GHz are to be agreed with Administrations pending a decision by the IEC.

5.6 System performance

5.6.1 BER performance

BER versus receive signal power level referred to point C of the RF block diagram given in figure 1.

See figure 7 for BER performance requirements.

5.6.2 Equipment background BER

The equipment background BER level range under simulated operating conditions without interference is measured with a signal level at point C which is between 15 dB and 40 dB above the level which gives BER = 10^{-3}. The measurement period shall be not less than 15 hours.

For systems less than 34 Mbit/s: BER < 10^{-10}.

For systems of 34 Mbit/s and above: BER < 10^{-11}.

All measurements are made at the system bit rate.

5.6.3 Interference sensitivity

All receive signals levels and Carrier/Interface (C/I) measurements should be referred to point C of the RF block diagram given in figure 1:

a) co-channel interference.

For a receiver operating at the 10^{-6} BER threshold given in figure 7 for system rates of 2 Mbit/s to 155 Mbit/s introduction of a like-modulated co-channel interferer at C/I of 23 dB shall not result in a BER greater than 10^{-5};

b) adjacent channel interference.

For a receiver operating at the 10^{-6} BER threshold given in figure 7, introduction of a like-modulated adjacent channel interferer at the level and frequency separation given in table 5 shall not result in a BER greater than 10^{-5};

c) continuous wave spurious interference.

For a receiver operating at the 10^{-6} BER threshold given in Fig 4, introduction of a continuous wave interferer at a level of + 24 dB or + 27 dB at the discretion of the administration, with respect to the "wanted" signal and at any frequency in the range 1 GHz to 130 GHz, excluding frequencies either side of the "wanted" frequency by up to twice the relevant co-polar channel spacing, shall not result in a BER greater than 10^{-5}.

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 test is not intended to imply a relaxed specification at all out-of-band frequencies.

Table 5: Adjacent channel separation and interference levels

Bit rate (Mbit/s)	Separation of wanted and unwanted signal (MHz)	Interference level (C/I (dB))
2	14	0
8	28	0
34	56	0
140/155	140	0
NOTE: Administrations may wish to vary the value of C/I for co-polar, adjacent channel interference. Values of C/I are typically in the range 0 to 3 dB.		

5.6.4 Distortion sensitivity

Distortion sensitivity is not likely to be significant for short hop operation. Signatures for systems are not required.

7 Parameters for wideband analogue systems

7.1 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) in excess of 10 MHz.

These may have subcarriers associated with them.

It is recognised that subcarriers will be used to carry four distinct traffic types:

- continuous wave (e.g. continuity pilot);
- low frequency analogue (e.g. audio);
- wideband analogue (e.g. secondary video);

- data (e.g. 2 Mbit/s).

7.2 Applications

The following applications are identified:

- point-to-point television (broadcast quality);
- point-to-point television (surveillance quality);
- point-to-point wideband video (radar remoting).

7.3 Baseband parameters

7.3.1 Video interfaces

Level: Nominally 1 V peak-to-peak.

Impedance: 75 ohms unbalanced.

Minimum return loss: 26 dB.

7.3.2 Audio interface (if applicable)

Level: 0 to 6 dBu (peak level + 9 to + 15 dBm).

Impedance: Input: 600 ohms symmetric;
Output: < 50 ohms symmetric;
Minimum return loss: 20 dB.

7.3.3 Digital interface (if applicable)

For CCITT bit rates the interface should conform to the relevant CCITT Recommendation (for example, 2 Mbit/s should conform to CCITT Recommendation G.703 [4]).

7.3.4 Intermediate Frequency (IF) interface (if applicable)

The characteristics for any IF interface shall be in accordance with CCIR Recommendation 403 [12].

7.3.5 Baseband performance

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

As an example some sample performance parameters are given in table 6, applicable to an analogue link carrying a Phase Alternate Line (PAL) video signal together with an audio channel.

Table 6: An 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 deg
Differential gain	± 2 %
Linear waveform distortion	2 %
Audio:	
Frequency response	± 1 dB
Total harmonic distortion	0,5 %
Noise - weighted	60 dBqOps
NOTE: All measurements made at 40 dB above the receive threshold as defined in subclause 7.6.1.	

The absolute performance characteristics for broadcast quality video and audio channels are available in the relevant CCIR (CMTT) or CCITT Recommendations.

7.4 Transmitter characteristics

7.4.1 Transmitter power range

Maximum output power up to 1 Watt at point C' of the RF block diagram given in figure 1.

7.4.2 Transmitter output power tolerance

The output power tolerance shall be within:

± 4 dB: classes 3.3 to 3.5 (defined in subclause 4.4.1.1) (all classes defined in subclause 4.4.1.2);

± 3 dB: classes 3.1 and 3.2 (defined in subclause 4.4.1.1).

7.4.3 Radiated spectrum

7.4.3.1 Spectrum masks

The equipment shall comply with the RF power spectrum mask given in figures 8 and 9. The 0 dB reference level shown on the spectrum masks relates to the peak of the modulated spectrum, and shall be set to the level of the unmodulated carrier. All spectrum masks include an allowance for frequency stability.

NOTE: Spectrum analyzer settings for RF power spectrum measurements should be:

Table 7

Video bandwidth (MHz)	< 3,5 MHz	< 14 MHz
Resolution bandwidth (kHz)	30	30
Total sweep width (MHz)	50	100
Video filter bandwidth (kHz)	0,3	0,3
Recommended scan time (s)	20	40

7.4.3.2 Frequency deviation

See table 8:

a) primary video.

The primary video may be defined as that traffic not carried on a subcarrier. No limit applies to the frequency deviation of the primary traffic;

b) subcarrier deviation of the main carrier.

The maximum subcarrier deviation for each type of traffic is given in table 8 and these limits apply both when the subcarrier is modulated or unmodulated.

Table 8: Transmitter characteristics maximum frequency deviations of the main carrier

Video baseband	< 3,5 MHz	< 6 MHz	< 10 MHz	< 14 MHz
Channel spacing	42 MHz	70 MHz	70 MHz	70 MHz
Maximum frequency deviation of the main carrier				
Primary video	No limit	No limit	No limit	No limit
Subcarriers:				
- continuous wave (pilot)	0,6 MHz	1 MHz	1 MHz	-
- narrow band analogue (audio)	0,6 MHz	2 MHz	2 MHz	-
- wideband analogue (video)	-	4 MHz	4 MHz	-
- digital	-	2 MHz	2 MHz	-
Spectrum mask	figure 8	figure 9	figure 9	figure 9

7.4.4 Spurious emissions

The transmitter shall be unmodulated, and the level of each spurious emission in the frequency range 1 GHz to 130 GHz, shall not exceed:

≥ 1 GHz and < 21,2 GHz: - 90 dBW

≥ 21,2 GHz and < 80 GHz: - 60 dBW

≥ 80 GHz and ≤ 130 GHz: - 50 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, intermodulation products and frequency conversion products, but exclude emissions which result from the modulation process.

NOTE 3: Definitions and methods of measurement for integrated equipment are under study.

NOTE 4: Methods of measurement for the frequency range 80 GHz to 130 GHz are to be agreed with Administrations pending a decision by the IEC.

7.4.5 RF frequency tolerance

RF frequency tolerances are included in the spectrum masks (see figures 8 and 9). The maximum allowable RF frequency tolerance must not exceed ± 100 ppm.

7.5 Receiver characteristics

All levels refer to point C on block diagram.

7.5.1 Input level range

From - 50 dBW to receive threshold as defined in subclause 7.6.1.

7.5.2 Spurious emissions

The frequency range in which the spurious emissions specifications apply is 1 GHz to 130 GHz. The limit values are:

≥ 1 GHz and < 21,2 GHz: - 90 dBW

≥ 21,2 GHz and < 80 GHz: - 60 dBW

≥ 80 GHz and ≤ 130 GHz: - 50 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, intermodulation products and frequency conversion products, but exclude emissions which result from the modulation process.

NOTE 3: Definitions and methods of measurement for integrated equipment are under study.

NOTE 4: Methods of measurement for the frequency range 80 GHz to 130 GHz are to be agreed with Administrations pending a decision by the IEC.

7.5.3 Noise figure

The receiver noise figure shall not exceed 15 dB.

7.6 Transmit/receive performance

7.6.1 Receiver threshold

The receiver threshold is defined as the receive signal level (referred to point C of the RF block diagram given 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 receiver threshold is defined in terms of the Frequency Modulation (FM) threshold of the equipment. 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 receiver level at which the relationship between the receive signal level and the output signal/noise ratio deviates by 3 dB. It is recognised that for a composite video signal (incorporating modulated subcarriers) 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 FM threshold.

7.6.2 Interference sensitivity

a) Co-channel interference.

For planning purposes it should be assumed that the level of co-channel interference into the wideband analogue channel should not exceed - 125 dBW. It should be recognised that the degradation in performance caused by this interference will depend on a number of equipment characteristics (e.g. deviation, receiver noise performance, etc.) and, therefore, it is 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.

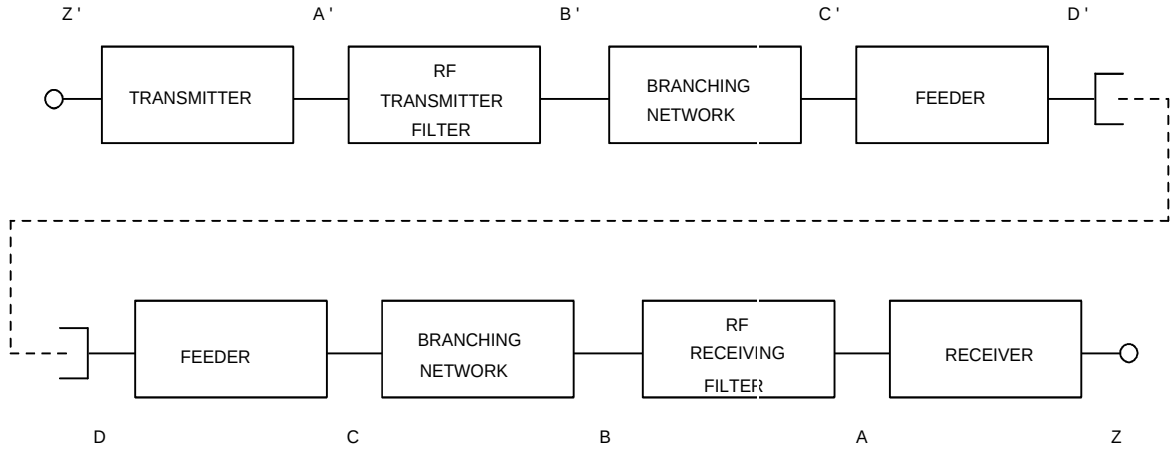
For a receiver operating with a "wanted" signal whose level is 9 dB above the receiver threshold measured in subclause 7.6.1, the introduction at point C of a like modulated interferer at the level and frequency separation given in table 9 should not result in a degradation of the output signal/noise ratio of more than 1 dB.

Table 9: Adjacent channel separation and interference levels

Video bandwidth (MHz)	Separation of wanted and interfering signal (MHz)	Interference level (C/I (dB))
< 3,5 MHz	42	0
< 6 MHz	70	0
< 10 MHz	70	0
< 14 MHz	70	0

c) continuous wave spurious interference.

For a receiver operating with a "wanted" signal whose level is 9 dB above the receiver threshold measured in subclause 7.6.1, the introduction at point C of a continuous wave interferer at a level of + 30 dB with respect to the "wanted" signal and at any frequency from 1 GHz to 130 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.



NOTE 1: For the purpose of defining the measurement points, the branching network does not include a hybrid.

NOTE 2: Points B, C, D, and B,' C', D' may coincide.

Figure 1: RF block diagram

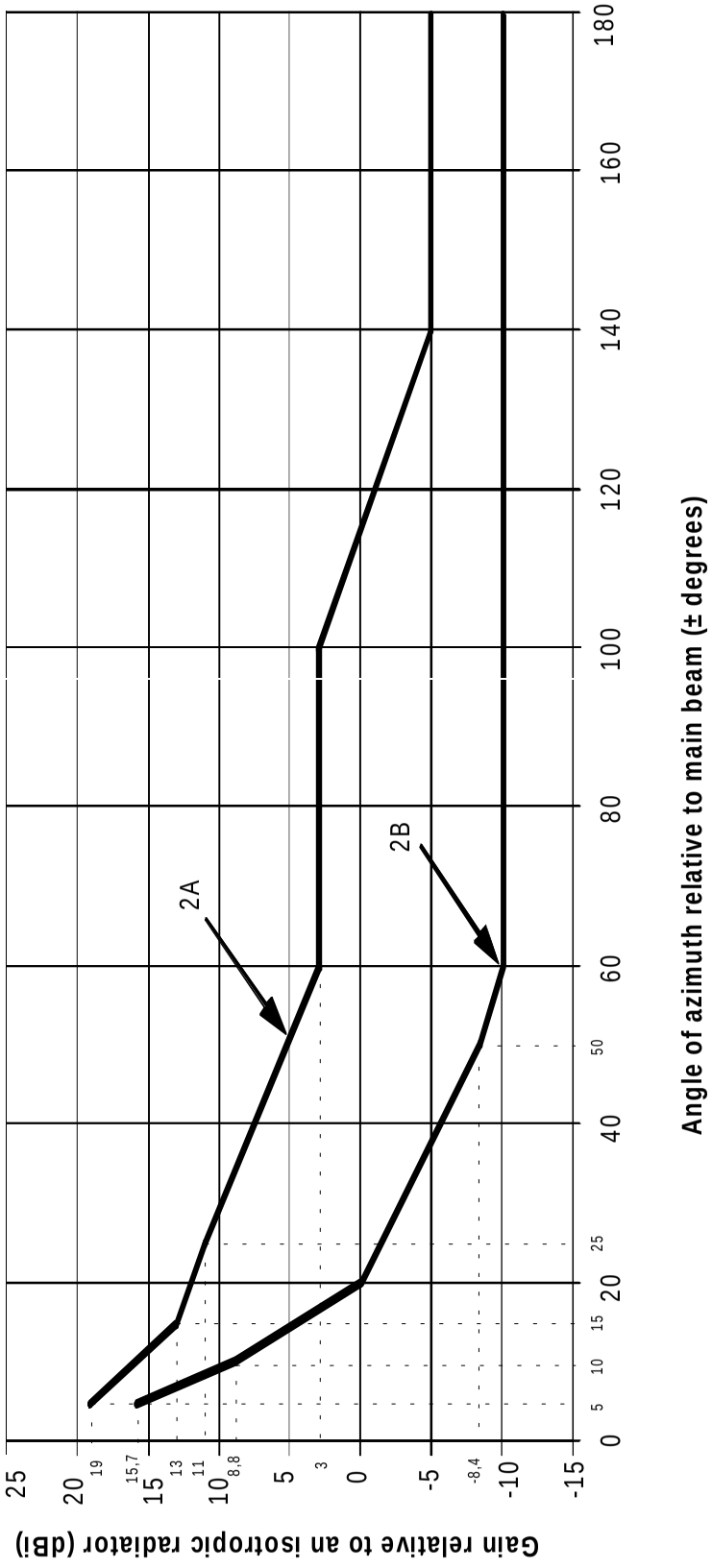


Figure 2: Limits of antenna gain for angles greater than 5° from the main beam axis

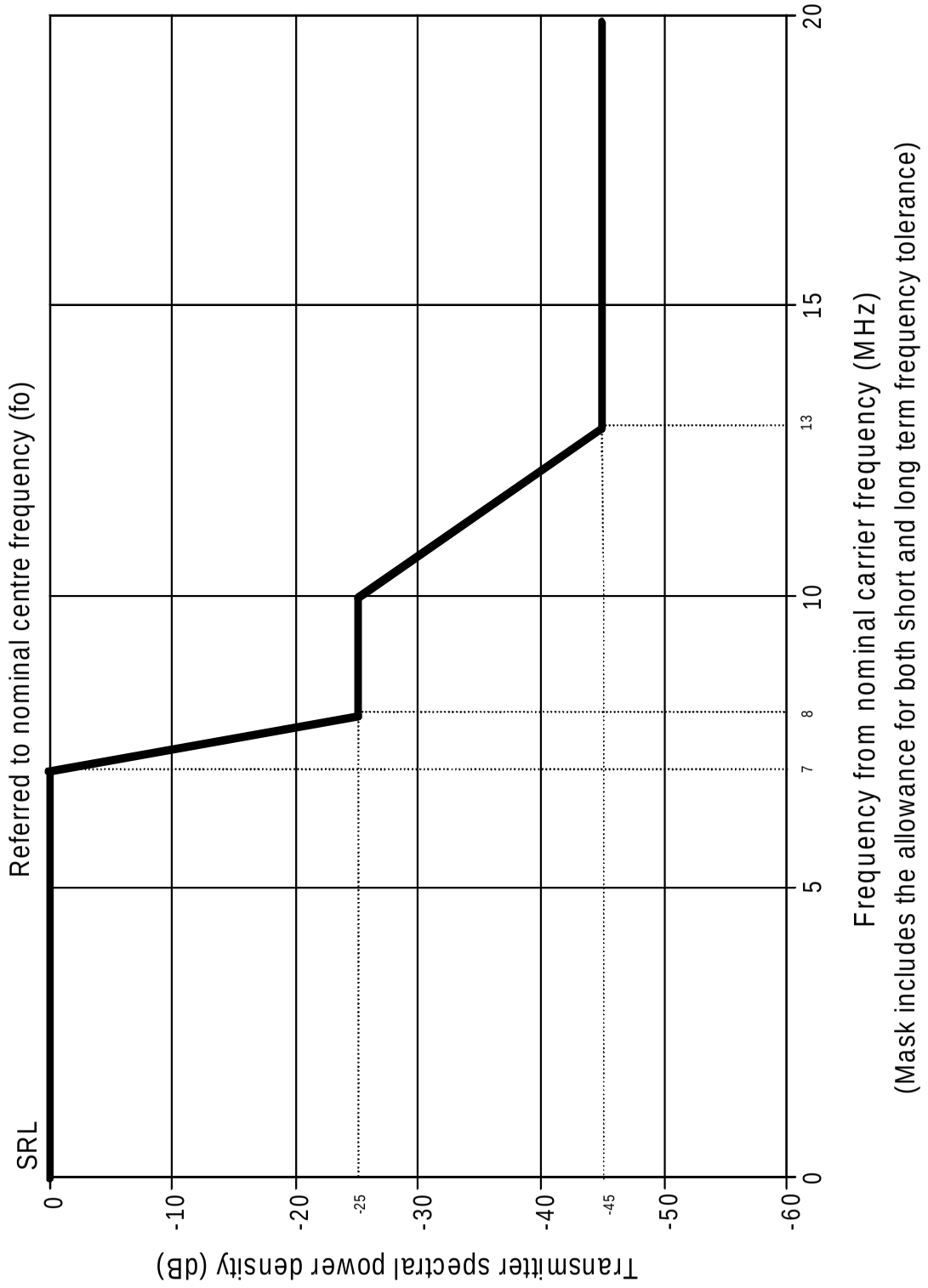


Figure 3: Limits of spectral power density for minimum system rate of 2 Mbit/s using channel spacing of 14 Mhz

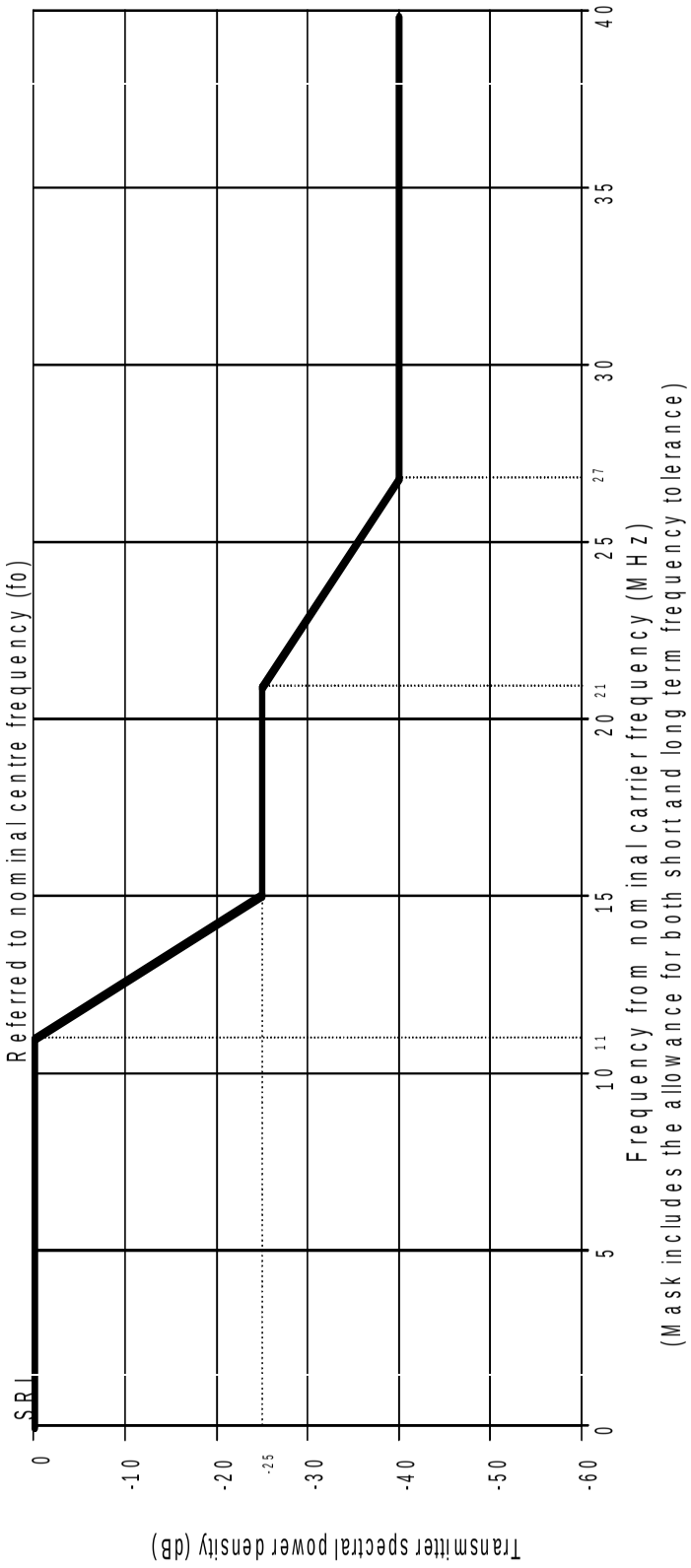


Figure 4: Limits of spectral power density for minimum system rate of 8 Mbit/s using channel spacing of 28 Mhz

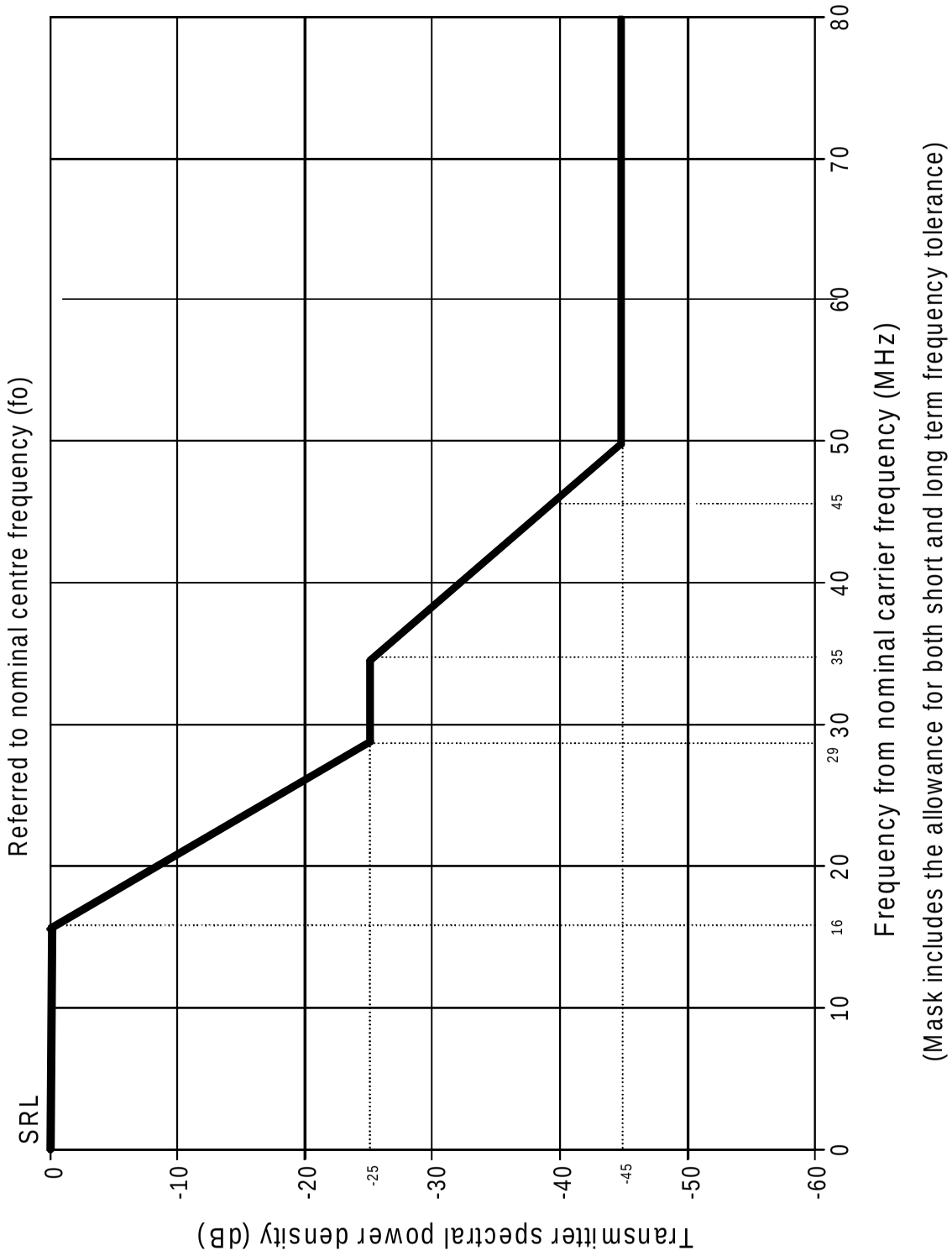


Figure 5: Limits of spectral power density for minimum system rate of 34 Mbit/s using channel spacing of 56 Mhz

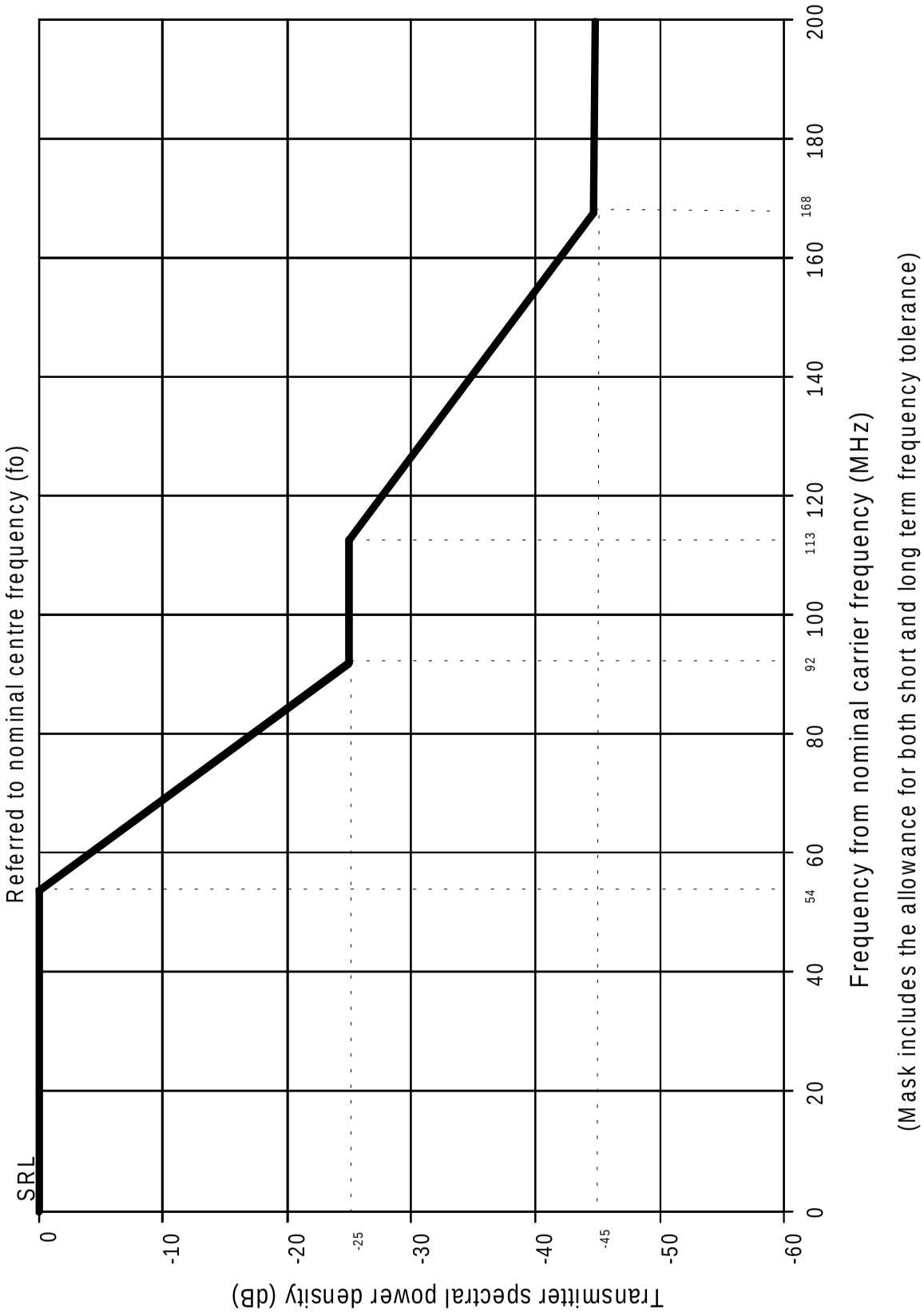
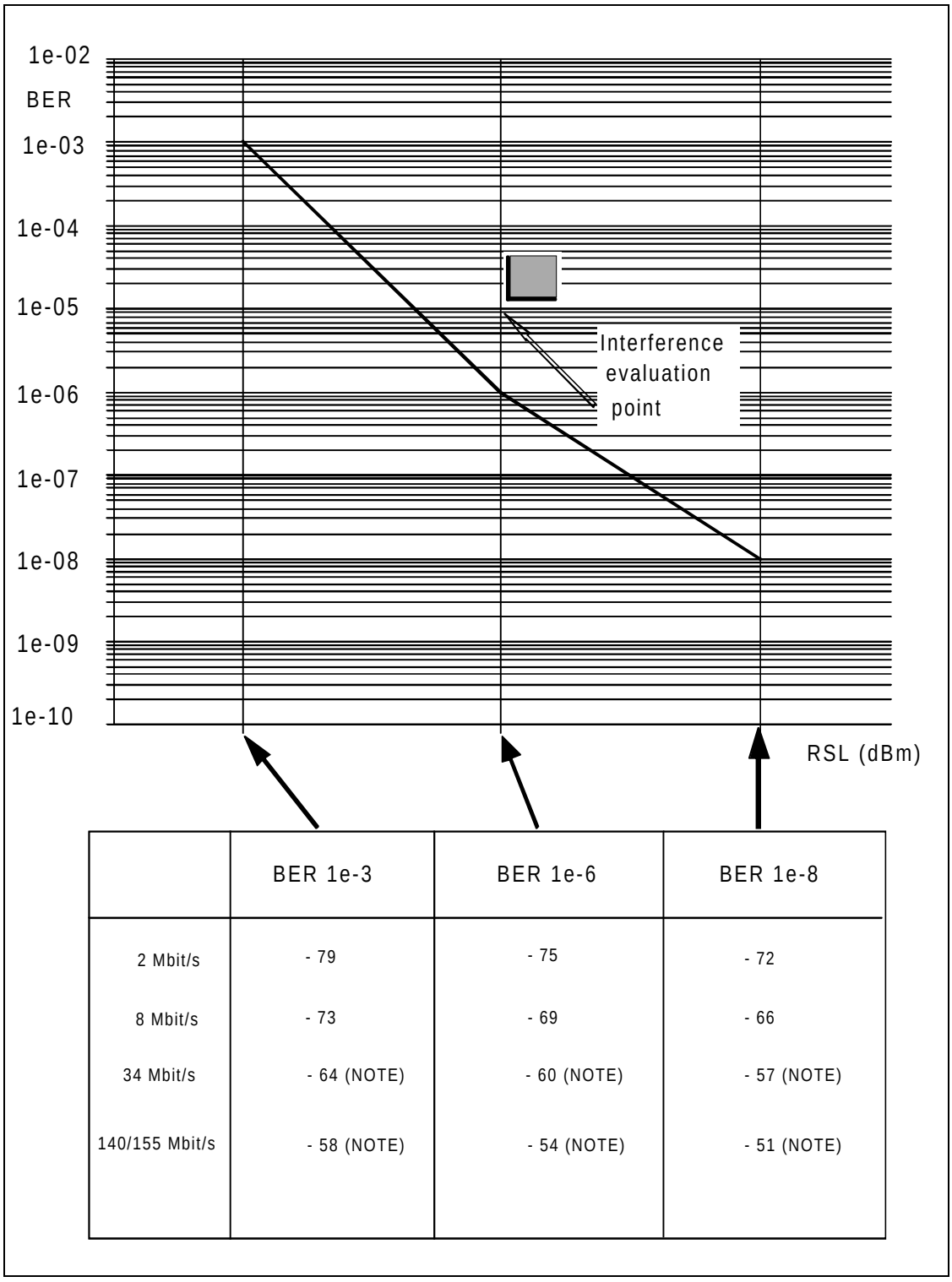


Figure 6: Limits of spectral power density for minimum system rate of 140/155 Mbit/s using channel spacing of 140 Mhz



	BER 1e-3	BER 1e-6	BER 1e-8
2 Mbit/s	- 79	- 75	- 72
8 Mbit/s	- 73	- 69	- 66
34 Mbit/s	- 64 (NOTE)	- 60 (NOTE)	- 57 (NOTE)
140/155 Mbit/s	- 58 (NOTE)	- 54 (NOTE)	- 51 (NOTE)

NOTE: In the future, ETSI may need to review these levels, due to advances in technology.

Figure 7: Bit Error Rate (BER) versus Receiver Signal Level (RSL)

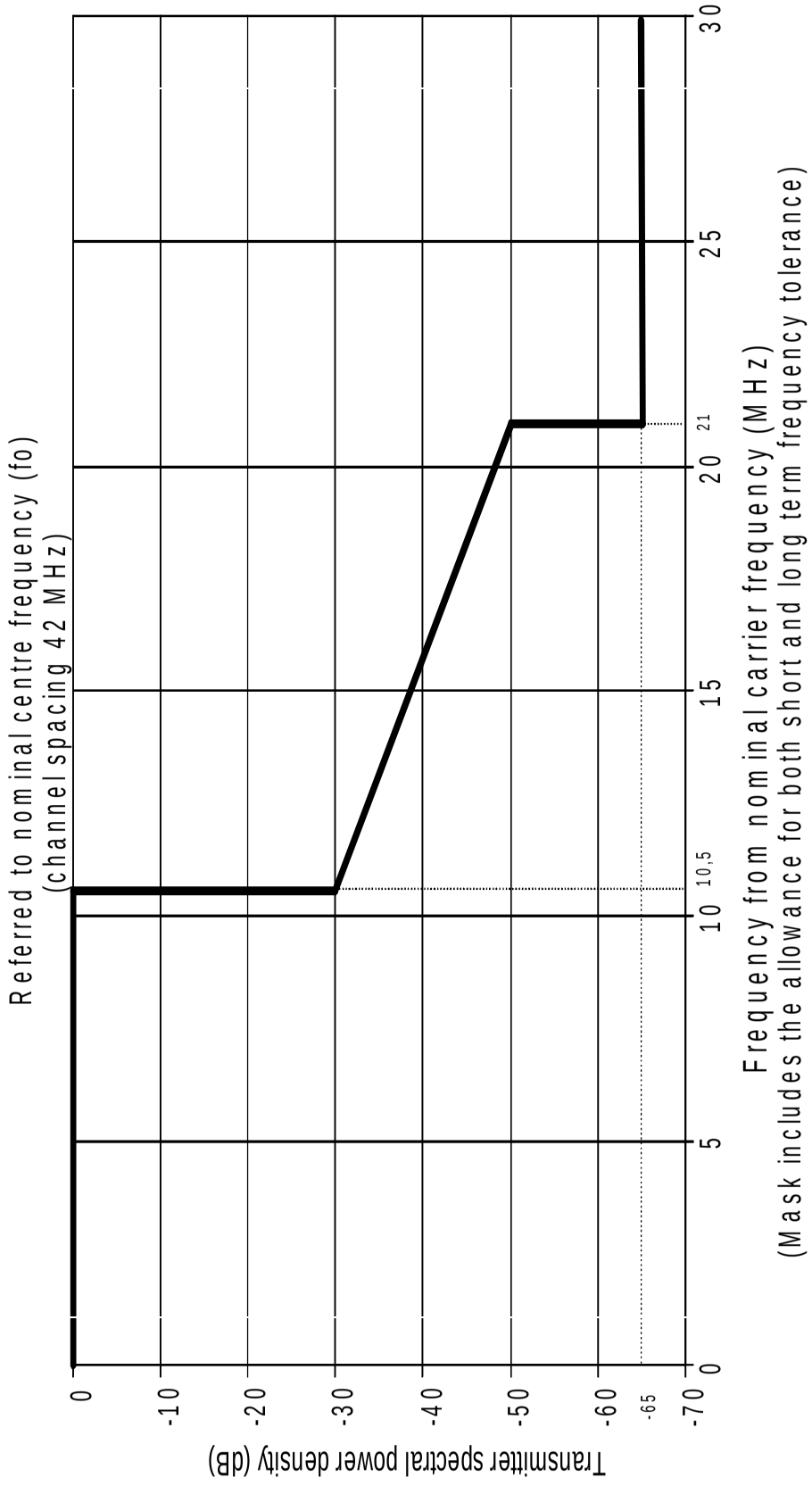


Figure 8: Limits of spectral power density for video basebands up to 3,5 MHz

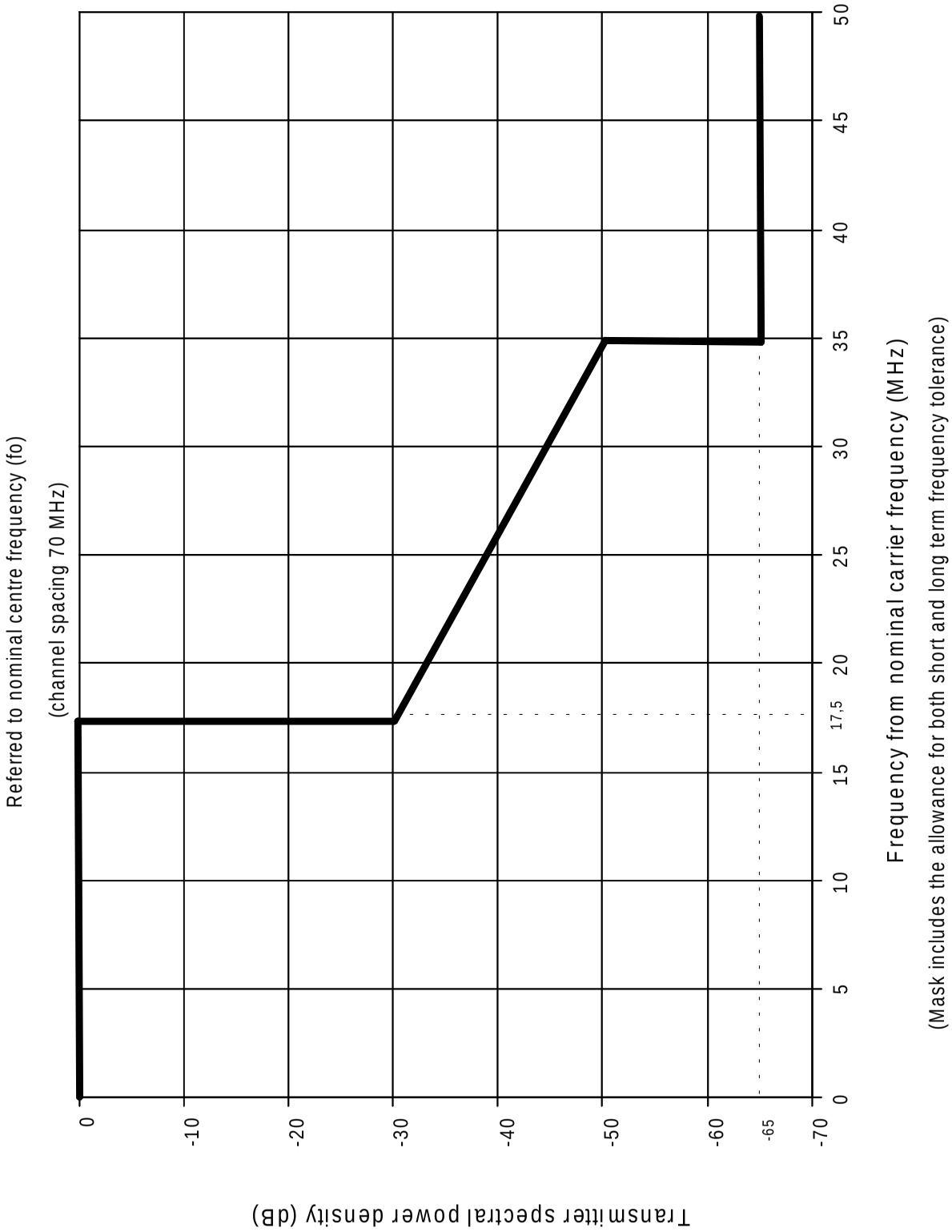


Figure 9: Limits of spectral power density for video basebands up to 14 MHz

Annex A (informative): Bibliography

The following references are used for informative purposes within this ETS.

CCIR Recommendation 696: "Error performance and availability objectives for the hypothetical reference digital sections utilizing digital radio-relay systems forming part or all of the medium grade portion of an ISDN connection".

CCIR Recommendation 697: "Error performance objectives for the local-grade portion at each end of an ISDN connection utilizing digital radio-relay systems".

CCIR Report 338: "Propogation data and prediction methods required for terrestrial line-of-sight systems".

CCIR Report 563: "Radiometeorological data".

CCIR Report 721: "Attenuation by hydrometeors, in particular precipitation, and other atmospheric particles".

CCIR Report 1053: "Error performance and availability objectives for digital radio-relay systems used in the local-grade portion of an ISDN connection".

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

History

Document history	
March 1994	Public Enquiry PE 59: 1994-03-21 to 1994-08-12
January 1996	Converted into Adobe Acrobat Portable Document Format (PDF)