

RECOMMENDATION ITU-R SM.851-1*

**SHARING BETWEEN THE BROADCASTING SERVICE AND THE FIXED
AND/OR MOBILE SERVICES IN THE VHF AND UHF BANDS**

(Question ITU-R 2/12)

(1992-1993)

The ITU Radiocommunication Assembly,

considering

- a) that the World Administrative Radio Conference, (Geneva, 1979) (WARC-79), increased the number of frequency bands that might be shared between the broadcasting service and the fixed and mobile services;
- b) that in many parts of the world, some bands are allocated, as specified in Article 8 of the Radio Regulations, to the fixed, mobile and broadcasting services on a co-primary basis;
- c) that some administrations have partitioned the VHF and UHF bands between the three services and this situation has created some difficulty in coordination between two or more administrations which share borders in the coverage areas and which use these bands for different services;
- d) that there is a requirement for standardized compatibility analysis procedures to facilitate the development of frequency assignment plans and equipment specifications applicable to national and multilateral arrangements;
- e) that careful planning of frequency assignments to broadcasting, fixed and land mobile stations will lead to improvement in spectrum utilization by minimizing harmful interference to operations in the adjacent or shared frequency bands;
- f) that fixed service applications in many parts of the world presently use the upper part of UHF television bands for radiotelephone links and are expected to remain for some time to come. However, new applications for those links in the fixed service are not expected to expand in these bands;
- g) that fixed and mobile applications for services ancillary to broadcasting are likely to be expanded in the VHF and UHF bands;
- h) that a variety of system characteristics exists for broadcasting, fixed and mobile service applications;
- j) that studies are progressing in the Radiocommunication Sector (ITU-R) concerning the compatibility between the broadcasting service and the fixed and mobile services, in particular concerning systems involving new technology,

recommends

1. that frequency separation, geographical separation and time sharing, or a combination thereof, be used to ensure compatibility where sharing is required between different services. In this context, frequency sharing refers to the subdivision of the allocated bands between different services, geographical separation refers to the simultaneous use of a frequency by different services in separate geographical areas, and time sharing refers to the use of separate hours of operation for each of the services;
2. that the procedure in Annex 1 be used to determine the protection margin for the broadcasting service (sound and television) when it is operated simultaneously with either the fixed or land mobile service in shared or in adjacent VHF or UHF bands;
3. that the procedure in Annex 2 be used to determine the protection margin for the land mobile service when it is operated simultaneously with the broadcasting service in shared or in adjacent VHF or UHF bands;

* Radiocommunication Study Group 1 made editorial amendments to this Recommendation.

4. that the procedure in Annex 3 be used to determine the protection margin for the fixed service when it is operated simultaneously with the broadcasting service in shared or in adjacent VHF or UHF bands;
5. that the system parameters related to determination of these protection margins include: minimum field strengths to be protected, protection ratios, antenna characteristics, propagation conditions and other related factors as described in Annexes 1, 2 and 3;
6. that the parameters contained in this Recommendation be used only for systems referred to in Annexes 1, 2 and 3;
7. that with the introduction of new technology (e.g. digital television, digital audio broadcasting, digital mobile and digital fixed) these parameters should be extended to accommodate future developments and to take account of ongoing Radiocommunication Sector (ITU-R) studies.

ANNEX 1

**Protection of the broadcasting service from the
fixed and land mobile services**

PART I

TO ANNEX 1

Television services

1. Minimum field strength to be protected

Table 1 gives the minimum field strength values to be protected at 10 m above ground level for the broadcasting service (television) and the wanted field strength values from which they are derived.

TABLE 1

	Band I (41-68 MHz)	Band II (76-100 MHz)	Band III (162-230 MHz)	Band IV (470-582 MHz)	Band V (582-960 MHz)
Field strength to be protected (dB(μ V/m)) at edge of coverage area (50% of time, 90% of locations)	46	48	49	53	58
Wanted field strength (dB(μ V/m)) at edge of coverage area (50% of time, 50% of locations) from Recommendation ITU-R BT.417	48	52	55	65	70

The field strength to be protected is derived from the wanted field strength by taking account of the need to protect 90% of locations and the relatively high man-made noise levels in the VHF bands.

However, the values given in Table 2 are used in North America for the wanted field strength at the edge of coverage area and for the field strength to be protected at 10 m above ground level (50% of time and 50% of locations in both cases).

TABLE 2

	54-88 MHz	174-216 MHz	470-806 MHz
Wanted field strength and field strength to be protected (dB(μ V/m)) at edge of coverage area (50% of time and 50% of locations)	47	56	64

2. Protection ratios

2.1 General

Protection ratios for the various television systems are given in Recommendation ITU-R BT.655. The values shown in this Annex are based on these texts as well as on the new studies carried out by some administrations.

Protection ratios covering tropospheric (T) and continuous (C) interference are included, the values being applicable to interference produced by one single source. The ratios applied to tropospheric (T) interference correspond closely to a slightly annoying impairment condition (Grade 3). They are considered to be acceptable only if the interference occurs for a small percentage of the time, not precisely defined but generally considered to be between 1% and 10%. For substantially non-fading unwanted signals, it is necessary to provide a higher degree of protection. In this case, the protection ratios appropriate to continuous (C) interference, which corresponds closely to perceptible but not annoying (Grade 4), should be used. If the latter ratios are not known, then the tropospheric (T) values increased by 10 dB can be applied.

Within a television channel, the required protection ratios for the vision and the sound signals should be considered separately.

Protection ratio requirements, particularly in the out-of-channel range, can be significantly increased due to non-linear effects in the receiver brought about by high level single or multiple unwanted input signals. Studies have shown that values can increase by up to 25 dB.

2.2 Protection ratios for the vision channel

The unwanted signal can fall into any part of the vision channel, therefore the protection ratios for overlapping channels given in Figs. 1 to 3, and Tables 4 to 6 (taken from Recommendation ITU-R BT.655) should be applied.

All the protection ratio values in the figures and tables are relevant for the case of an unwanted CW signal or FM signal, falling into the vision channel, the wanted vision signal being negatively modulated.

The corrections which should be made for positively modulated wanted vision signals and for other types of potentially interfering signals are given in Table 3.

2.2.1 525-line systems

The protection ratio values to be applied for 525-line systems are given in Fig. 1 and Table 4 for tropospheric interference.

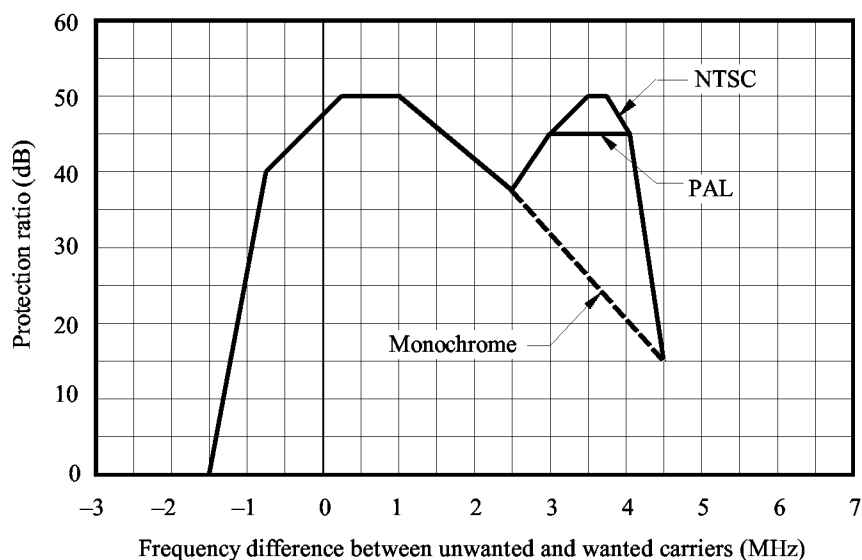
For continuous interference the values should be increased by 10 dB.

TABLE 3

Correction values for different wanted and unwanted signals

Wanted signal	Unwanted signal	Correction factors (dB)		
		CW	FM	AM
Vision signal negative modulated		0	0	0
Vision signal positive modulated		−2	−2	−2

FIGURE 1 and TABLE 4
525-line systems (M/NTSC and M/PAL) Tropospheric interference
 Unwanted signal: CW carrier



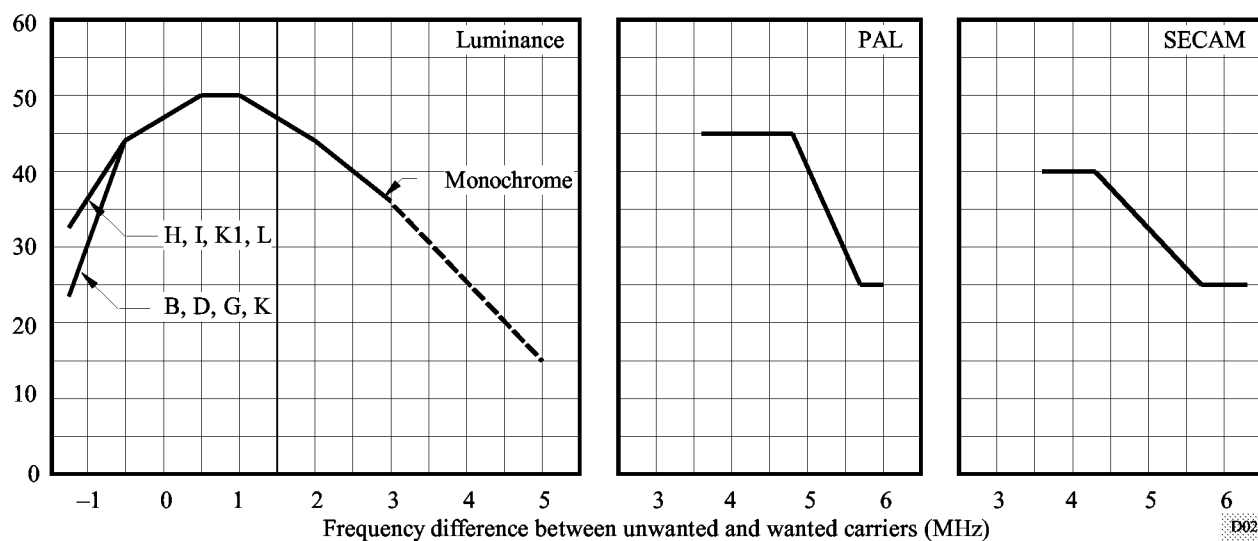
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Frequency difference (MHz)	−1.5	−1.0	−0.75	0.3	1.0	2.5	3.0	3.5	3.7	4.1	4.5
NTSC (dB)	0	30	40	50	50	37	45	50	50	45	15
PAL (dB)								45	45		
Monochrome (dB)								26	25	20	

2.2.2 625-line systems

The protection ratio values to be applied for 625-line systems are given in Figs. 2 and 3, and Tables 5 and 6.

FIGURE 2 and TABLE 5
625-line systems
Tropospheric interference



Frequency difference between unwanted and wanted carriers (MHz)												
Luminance range									PAL		SECAM	
MHz	-1.25 ⁽¹⁾	-1.25 ⁽²⁾	-0.5	0.0	0.5	1.0	2.0	3.0	3.6-4.8	5.7-6.0 ⁽³⁾ ⁽⁴⁾	3.6-4.3 ⁽⁵⁾	5.7-6.3 ⁽³⁾ ⁽⁴⁾
dB	32	23	44	47	50	50	44	36	45	25	40	25

(1) H, I, K1, L television systems.

(2) B, D, G, K television systems.

(3) B, G television systems: range is 5.3-6.0 MHz.

(4) This value is valid until the end of the channel.

(5) D/SECAM and K/SECAM: add 5 dB.

2.3 Protection ratios for the sound channel

2.3.1 Analogue sound systems (one or two-sound carrier systems)

Protection ratio values for analogue sound signals are given in Table 7.

In the case of a two-sound carrier system each sound carrier must be considered separately.

The maximum deviation of the wanted FM sound carrier is assumed to be 50 kHz. Corrections should be made for other deviations.

2.3.2 Digital sound systems

Some values for the protection of digital sound signals are given in Table 8.

2.4 Protection ratios for out-of-channel interference

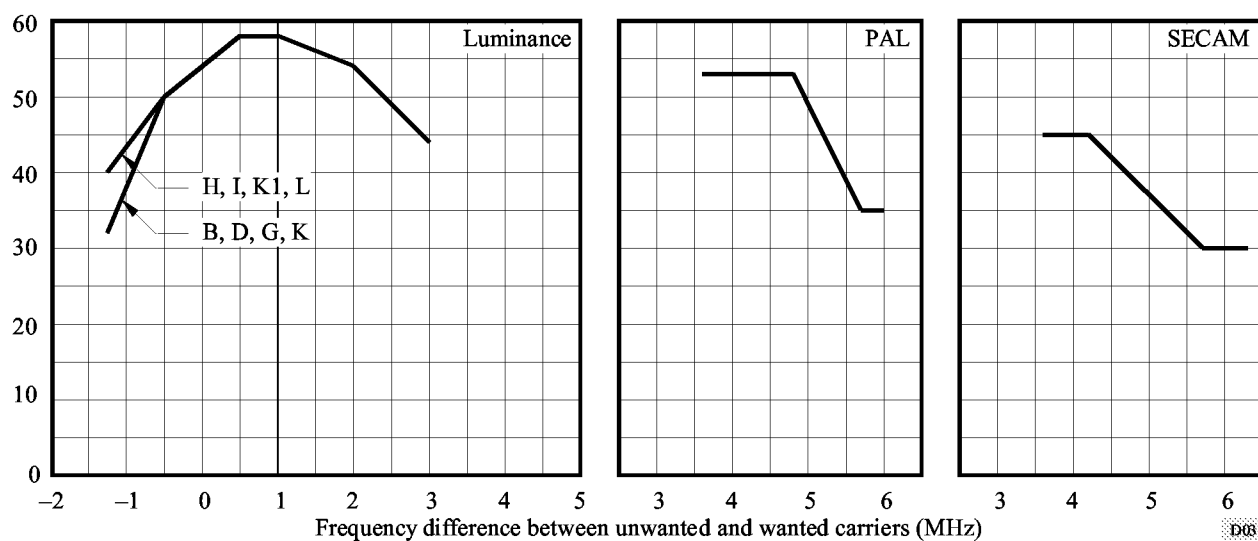
2.4.1 Adjacent channels

2.4.1.1 525-line systems

The protection ratio values to be applied for 525-line systems are given in Figs. 4a and 4b and Table 9 for continuous and tropospheric interference.

FIGURE 3 and TABLE 6

625-line systems
Continuous interference



Frequency difference between unwanted and wanted carriers (MHz)												
Luminance range								PAL		SECAM		
MHz	-1.25 ⁽¹⁾	-1.25 ⁽²⁾	-0.5	0.0	0.5	1.0	2.0	3.0	3.6-4.8	5.7-6.0 ⁽³⁾ ⁽⁴⁾	3.6-4.3 ⁽⁵⁾	5.7-6.3 ⁽³⁾ ⁽⁴⁾
dB	40	32	50	54	58	58	54	44	53	35	45	30

- (1) H, I, K1, L television systems.
 (2) B, D, G, K television systems.
 (3) B, G television systems: range is 5.3-6.0 MHz.
 (4) This value is valid until the end of the channel.
 (5) D/SECAM and K/SECAM: add 8 dB.

TABLE 7

Protection ratios for wanted analogue sound carriers of a television signal (dB)
Unwanted signal: CW or FM sound carrier

Difference between wanted sound carrier and unwanted carrier (kHz)	Wanted sound signal			
	Tropospheric interference		Continuous interference	
	FM	AM	FM	AM
0	32	49	39	56
15	30	40	35	50
50	22	10	24	15
250	-6	7	-6	12

TABLE 8

Protection ratios for wanted digital sound carriers of a television signal (dB)

(No frequency separation)

Wanted	Unwanted	FM/CW ⁽¹⁾	AM ⁽¹⁾	Digital ⁽²⁾
Digital	T	12	11	12
	C	12	11	12

(1) The values given incorporate an additional 6 dB safety margin to allow for the sudden onset of severe degradation of the digital sound system in the presence of interference. For the same reason, there is no difference between the protection ratios for tropospheric and continuous interference.

(2) Protection ratios for unwanted digital broadcasting signals (refer to Recommendation ITU-R BT.655).

FIGURE 4a

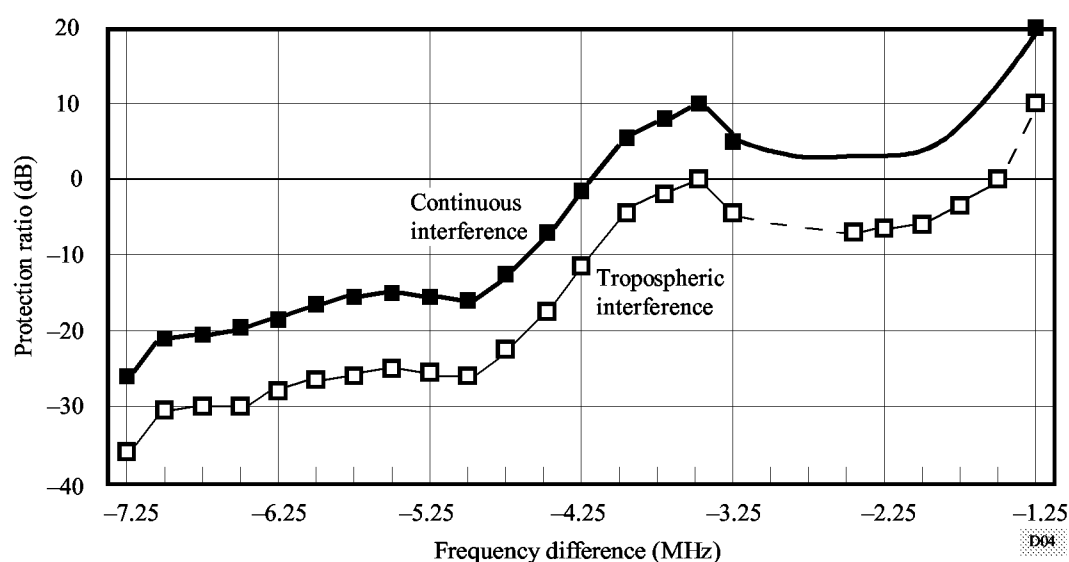
Protection ratios for the lower adjacent channel, NTSC/system M

FIGURE 4b

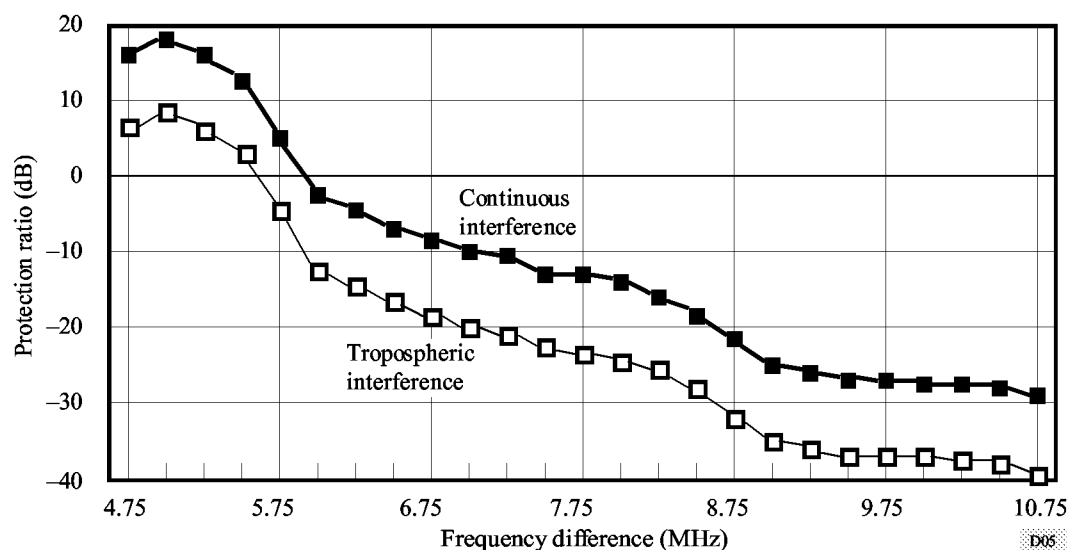
Protection ratios for the upper adjacent channel, NTSC/system M

TABLE 9

Protection ratios for the adjacent channels, 525-line NTSC systems

Frequency difference (MHz)	Protection ratio (dB)	
	Continuous	Tropospheric
−7.25	−26	−36
−5.25	−15	−25
−3.5	10	0
−2.25	3	−7
−1.25	20	10
4.75	16	6
5.75	5	−5
6.75	−9	−19
8.75	−22	−32
10.75	−30	−40

2.4.1.2 625-line systems

The protection ratio values to be applied for 625-line systems are given in Table 10 and in Figs. 5 and 6 for tropospheric and continuous interference. For system I/PAL the values for the lower adjacent channel are given in Fig. 7 and Table 11.

TABLE 10

Protection ratios for the adjacent channels, 625-line systems

Frequency difference (MHz)	Protection ratio (dB)		
	Continuous	Tropospheric	TV systems
−14.0	−10	−15	B, D, G, H, K, K1, L
−6.0	−10	−15	B, D, G, H, K, K1, L
−2.5	11	1	B, D, G, H, K, K1, L
−1.5	11	1	B, D, G, H, K, K1, L
−1.25	40	32	H, K1, L
−1.25	32	23	B, D, G, K
5.75	30	25	B, G, H/SECAM
5.75	35	25	B, G, H/PAL
6.2	−2	−12	B, G, H
6.75	30	25	L, D, K, K1/SECAM
8.5	−2	−12	L, D, K, K1/SECAM
15.0	−2	−12	B, D, G, H, K1, L

FIGURE 5
Protection ratios for the adjacent channels, 625-line systems
tropospheric interference

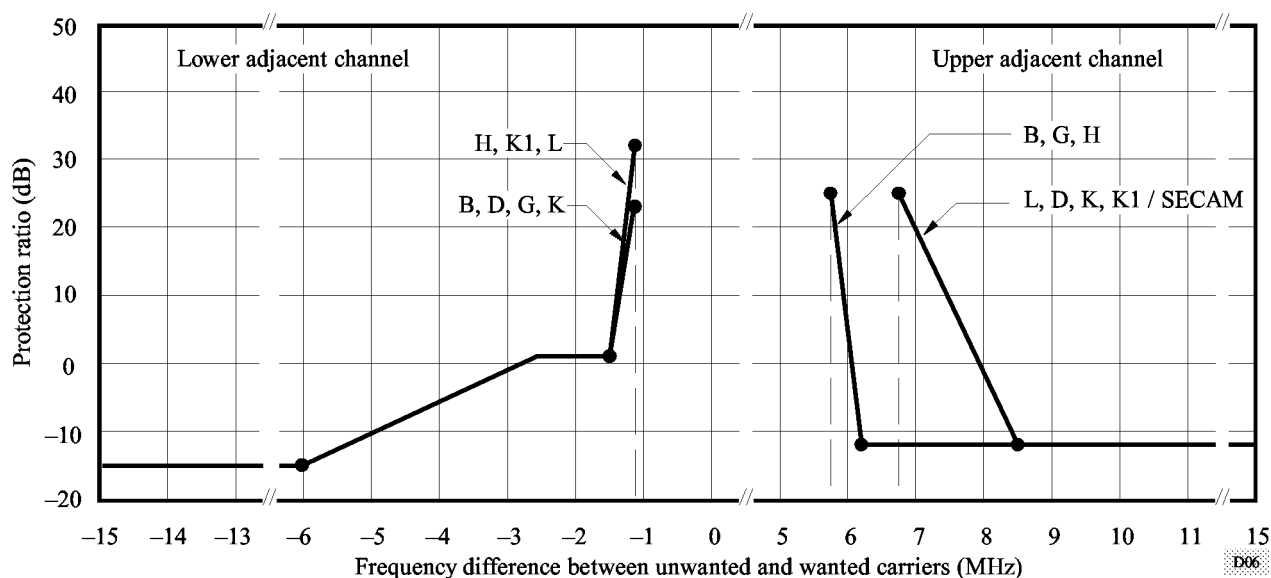


FIGURE 6
Protection ratios for the adjacent channels, 625-line systems
continuous interference

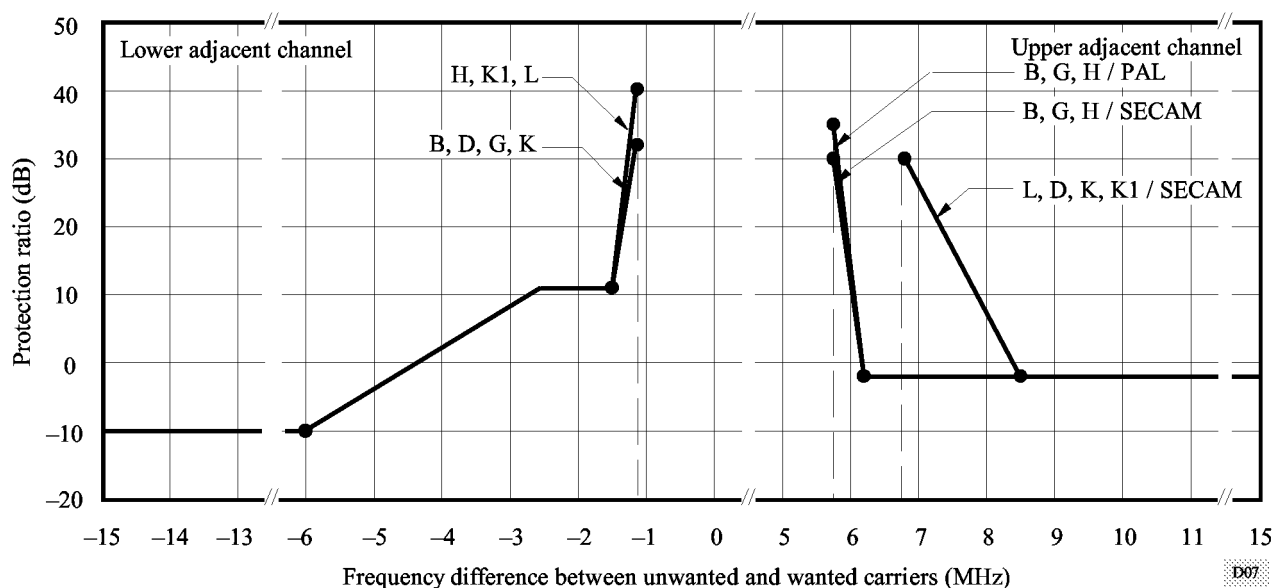


FIGURE 7a

Protection ratios for the lower adjacent channel, 625 lines I/PAL system

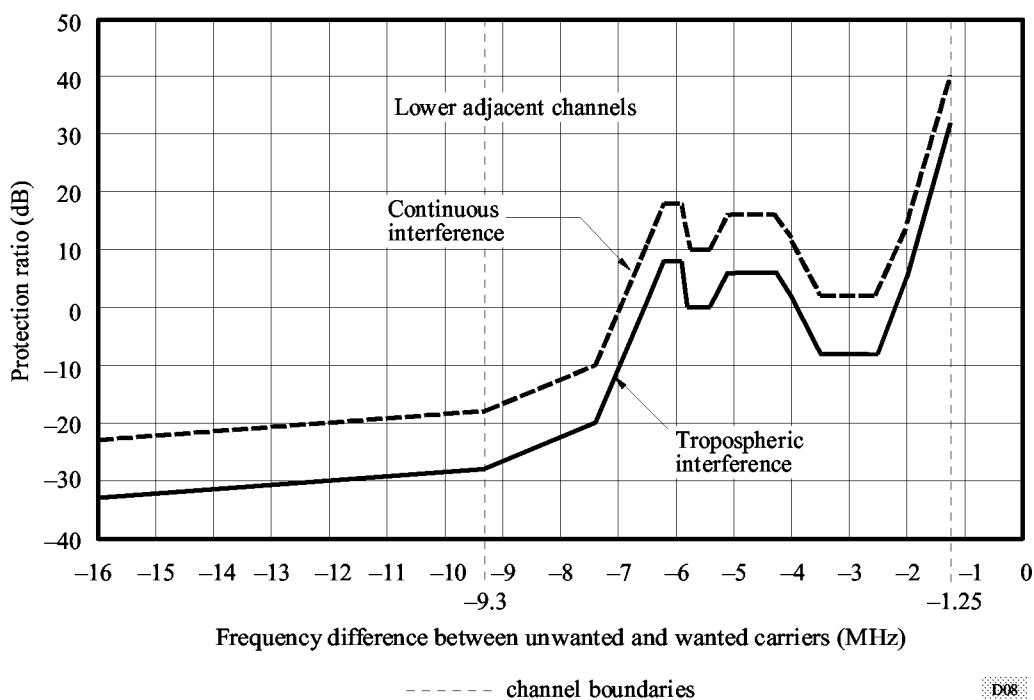


FIGURE 7b

Protection ratios for the upper adjacent channel, 625 lines I/PAL system

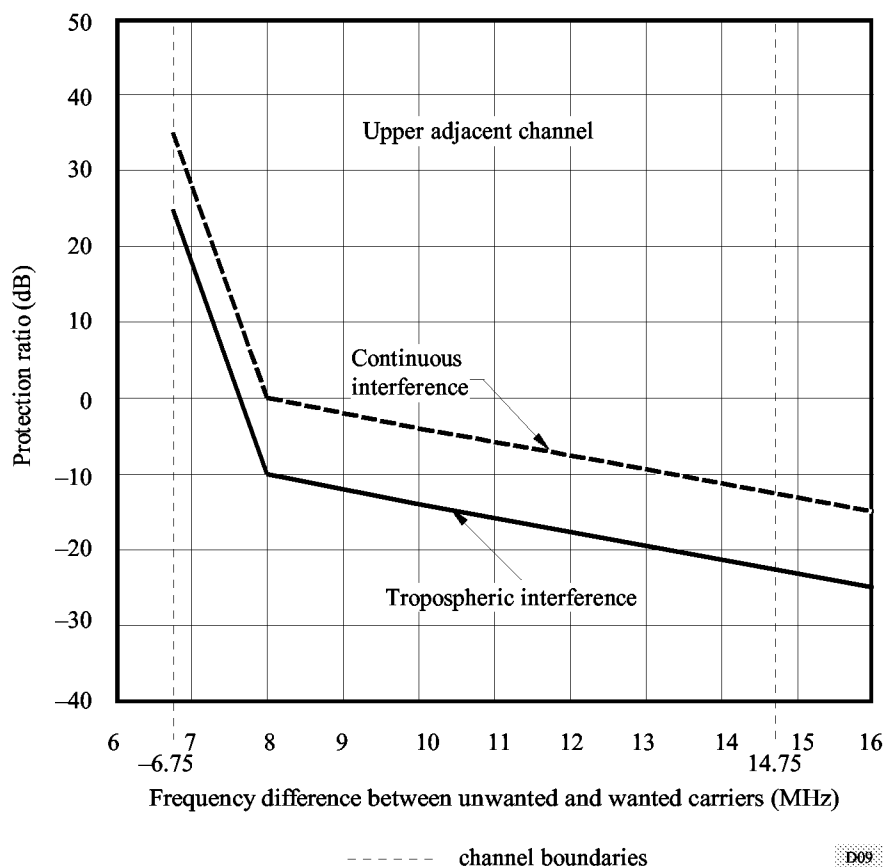


TABLE 11

Protection ratio for the adjacent channels, 625 lines I/PAL system

Frequency difference (MHz)	Protection ratio (dB)	
	Continuous	Tropospheric
−16.0	−23	−33
−9.3	−18	−28
−7.4	−10	−20
−6.5	11	1
−6.2	18	8
−5.9	18	8
−5.8	10	0
−5.4	10	0
−5.1	16	6
−5.0	16	6
−4.3	16	6
−4.0	12	2
−3.5	2	−8
−3.0	2	−8
−2.5	2	−8
−2.0	14	4
−1.25	40	32
+6.75	35	25
+8.0	0	−10
+10	−4	−14
+14.75	−13	−23
+16.0	−15	−25

2.4.2 Image channels

The protection ratio required will depend on the intermediate frequency and image-channel rejection of the receiver, and on the type of unwanted signal falling in the image channel. It can be determined by subtracting the image rejection figure from the required protection ratio given in § 2.2 and 2.3 above.

Image-channel rejection:

systems D and K/SECAM : 45 dB (VHF) and 30 dB (UHF)

system D/PAL: 45 dB (VHF) and 40 dB (UHF)

system I: 50 dB (UHF)

system M (Japan): 60 dB (VHF) and 45 dB (UHF)

all other systems: 40 dB (UHF).

2.4.3 Other types of interference

In the out-of-channel range some specific frequencies, depending upon the technology used in the TV receiver, such as local oscillator frequency, IF spacing, half IF spacing, etc., may require higher values of protection ratio.

3. Protection margin for television services

The protection margin (PM) is given (dB) by:

$$PM = FS - \text{combined value of } (NF + AF) \text{ for all interfering sources}$$

where:

FS : relevant field-strength value (dB(μV/m)) given in § 1 above

AF : adjustment factor (dB), intended to deal with antenna discrimination and clutter loss (see § 4.1 below)

NF : nuisance field and the larger of E_C and E_T given below (dB(μV/m)).

For continuous interference:

$$E_C = E_{(50,50)} + P + A_C$$

For tropospheric interference:

$$E_T = E_{(50,t)} + P + A_T$$

where:

$E_{(50,t)}$: field strength (dB(μV/m)) of the interfering transmitter, normalized to 1 kW, and exceeded during $t\%$ of the time, determined using Recommendation ITU-R PN.370.

For tropospheric interference the value of t is between 1 and 10 (the precise value should be specified by each administration)

P : e.r.p. (dB(kW)) of the interfering transmitter

A : protection ratio (dB)

and where the indices C and T indicate continuous and tropospheric interference respectively.

The protection ratio for continuous interference is applicable when the resulting nuisance field is stronger than that resulting from tropospheric interference, that is, when:

$$E_C > E_T$$

This means that E_C should be used in all cases when:

$$E_{(50,50)} + A_C > E_{(50,t)} + A_T$$

The calculated protection margin should be positive at all locations where a television service is required.

The combination of multiple interference from co-sited and non co-sited sources is discussed in § 4.2 and 4.3 below.

Information regarding fixed services or base stations of the land mobile service with effective antenna heights of less than 37.5 m is given in § 4.4 below.

4. Additional factors to be considered

4.1 Adjustment factors (AF)

Four distinct cases of interference to a station of the television service from stations of the fixed or land mobile services can be identified; these are dealt with separately below.