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ITU-R
Radiocommunication Sector of ITU

Recommendation ITU-R BT.1206-3
(04/2016)

**Spectrum limit masks for digital
terrestrial television broadcasting**

BT Series
Broadcasting service
(television)



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P	Radiowave propagation
RA	Radio astronomy
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SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
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Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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RECOMMENDATION ITU-R BT.1206-3

Spectrum limit masks for digital terrestrial television broadcasting

(Question ITU-R 132/6)

(1995-2013-2014-2016)

Scope

This Recommendation provides specific spectrum limit masks for digital terrestrial television broadcasting systems specified in Recommendation ITU-R BT.1306. While Recommendation ITU-R SM.1541 provides out-of-band domain emission limits that should be regarded as generic spectrum limit masks, specific spectrum limit masks might be required for specific environments to enhance compatibility with other radiocommunication services.

Keywords

Spectrum mask, Digital Terrestrial Television Broadcasting (DTTB), ATSC, DVB-T, ISDB-T, DTMB.

The ITU Radiocommunication Assembly,

considering

- a)* that for efficient planning for terrestrial broadcasting the spectrum limits for digital television should be defined for maximum compatibility;
- b)* that the error-correction, data framing, modulation and emission methods for digital terrestrial television broadcasting (DTTB) systems are specified in Recommendation ITU-R BT.1306;
- c)* that planning criteria for digital terrestrial television services in the VHF/UHF bands are specified in Recommendation ITU-R BT.1368;
- d)* that digital terrestrial television broadcasting may share frequency bands with analogue terrestrial television broadcasting and other radiocommunication services;
- e)* that Recommendation ITU-R SM.1541 provides unwanted emissions in the out-of-band (OoB) domain in the frequency range of 9 kHz to 300 GHz including OoB domain emission limits for television broadcasting systems;
- f)* that the spectrum limits specified in Recommendation ITU-R SM.1541 should be regarded as generic limits, which generally constitute the least restrictive OoB emission limits, sometimes called safety net limits, successfully used as national or regional regulations;
- g)* that Recommendation ITU-R SM.1541 states that the development of more specific spectrum limit masks for each system and in each channel bandwidth should be encouraged by administrations, taking into account the actual application, modulation, filtering capabilities of the system and also taking care to enhance compatibility with other radio services operating in co-frequency or adjacent bands;
- h)* that specific spectrum limit masks for DTTB are defined in some countries or regions where tighter limits are required for efficient planning,

recommends

that the spectrum limit masks for digital terrestrial television broadcasting systems in the VHF/UHF bands should be based on those given in Annexes 1, 2, 3 and 4 where specific spectrum limit masks are required beyond the general spectrum limit masks specified in Recommendation ITU-R SM.1541.

Introduction

This Recommendation contains the following Annexes:

Annex 1 – Specific spectrum limit masks for digital terrestrial television system A (ATSC).

Annex 2 – Specific spectrum limit masks for digital terrestrial television system B (DVB-T).

Annex 3 – Specific spectrum limit masks for digital terrestrial television system C (ISDB-T).

Annex 4 – Specific spectrum limit masks for digital terrestrial television system D (DTMB).

The spectrum limit mask defines emission limits in the in-band and out-of-band domain.

The relative power level is defined in a reference bandwidth of 4 kHz. The 0 dB reference level corresponds to the mean output power measured in the channel bandwidth.

Annex 1

Specific spectrum limit masks for digital terrestrial television system A (ATSC)

1 DTTB System A

The spectrum limit masks described in this Annex are applicable to the ITU-R digital terrestrial television broadcasting (DTTB) System A employing the 6 MHz single carrier modulation scheme, eight-level Vestigial-SideBand (8-VSB) modulation.

2 Sampling the transmitter output

To examine the spectrum, the output port of the transmitter (including any RF channel-defining filters) is connected to a spectrum analyser via a coupler or sampling device inserted in the transmission line (coaxial cable or waveguide) between the transmitter and its load or antenna. During the measurement, the transmitter may be operated into either an antenna or a dummy load. The dummy load is preferred, as it minimizes possible problems with off-air signal ingress. The spectrum shaping limits are based upon a measurement (or resolution) bandwidth of 500 kHz. Other measurement bandwidths may be used as long as appropriate correction factors are applied. Measurements need not be made any closer to the channel edge than one-half of the resolution bandwidth of the measuring instrument.

3 Spectrum limit mask for 6 MHz DTTB systems using 8-VSB modulation

The following 6 MHz DTTB spectrum limit masks required outside of the 6 MHz channel are stated relative to a reference amplitude. The reference amplitude for the spectrum shaping limit is the total

transmitter output power, including the pilot signal, contained within the 6 MHz channel. Three cases are considered below. The “high power” spectrum limit mask is intended for high-power transmitters which service large populated areas. These transmitters may be co-located with similar transmitters on adjacent channels avoiding interference. The “low power” spectrum limit mask is intended for low power television (LPTV) transmitters and translators. An LPTV transmitter provides a locally-oriented television service in small communities both rural and within larger urban areas. TV translator stations are stations in the broadcast service operated for the purpose of retransmitting the programmes and signals of a TV broadcast station in areas of poor reception. The “simple” spectrum limit mask is also intended for LPTV transmitters and translators in locations where such transmitters and translators will not cause interference.

A recommended practice for the measurement of these masks can be found in IEEE Std.1631¹.

3.1 High power DTTB spectrum limit mask

- The spectrum shaping limit in the range between one-half of the width of the resolution bandwidth filter used and 500 kHz from the channel edge relative to the total transmitter output power should be:

$$\text{Spectrum shaping limit} \leq -47 \text{ (dB}_{\text{DTV}}) \quad (1)$$

- The spectrum shaping limit at any frequency between 500 kHz and 6 MHz from the channel edge should be:

$$\text{Spectrum shaping limit} \leq -(11.5 (|\Delta F| - 0.5) + 47) \text{ (dB}_{\text{DTV}}) \quad (2)$$

where:

ΔF is the frequency difference, in MHz, from the channel edge.

- The spectrum shaping limit at any frequency more than 6 MHz from the channel edge should be:

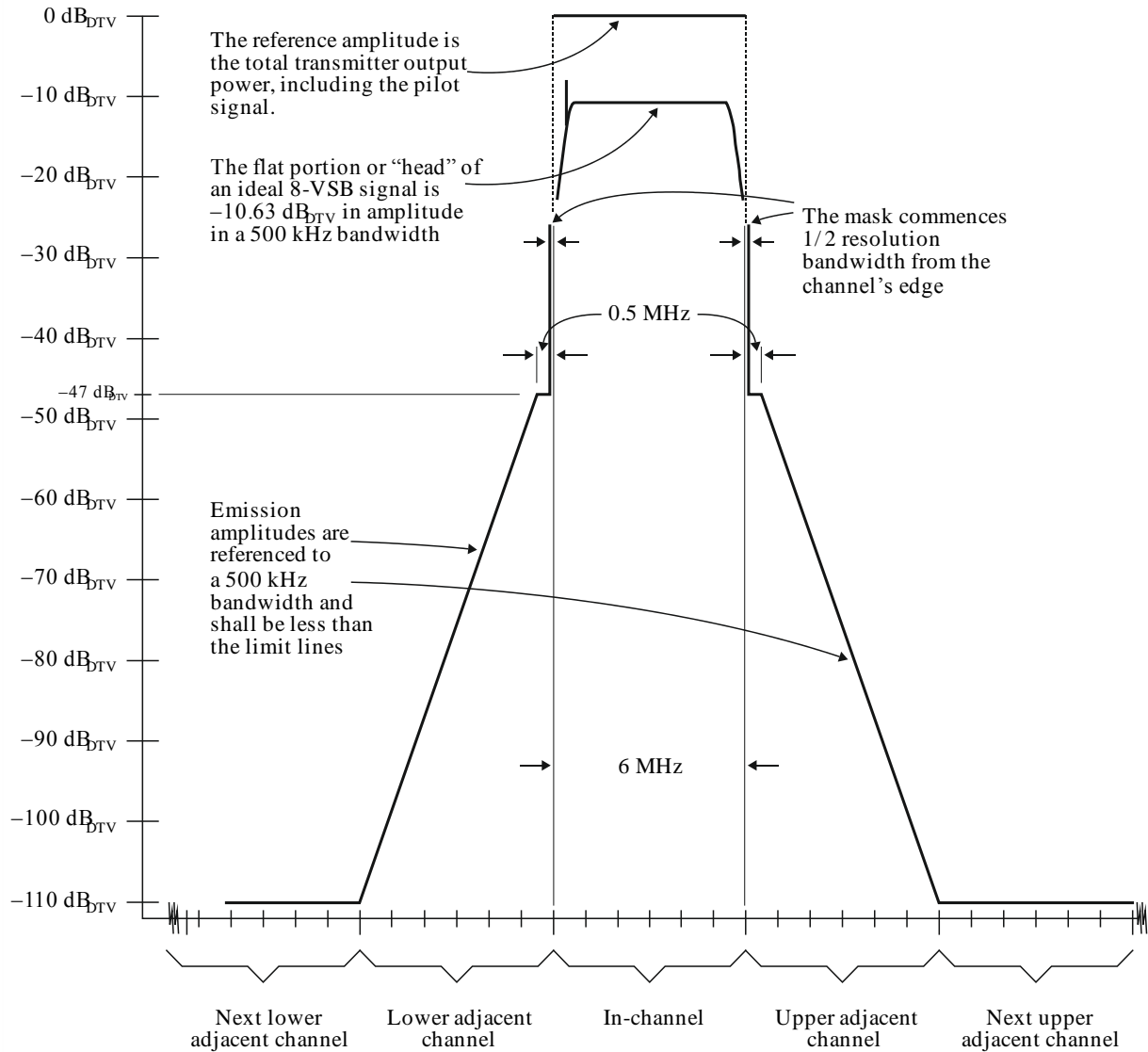
$$\text{Spectrum shaping limit} \leq -110 \text{ dB}_{\text{DTV}} \quad (3)$$

The spectrum limit mask for a high power DTTB transmitter is illustrated graphically in Fig. 1.

¹ IEEE Std. 1631-2008, IEEE Recommended Practice for Measurement of 8-VSB Digital Television Transmission Mask Compliance for the USA.

FIGURE 1

Spectrum limit mask for 6 MHz high power 8-VSB digital terrestrial television systems



BT.1206-01

3.2 Low power DTTB spectrum limit mask for LPTV transmitters and translators

- The spectrum shaping limit in the range between one-half of the width of the resolution bandwidth filter used and 500 kHz from the channel edge relative to the total transmitter output power should be:

$$\text{Spectrum shaping limit} \leq -47 \text{ (dB}_{\text{DTV}}) \quad (4)$$

- The spectrum shaping limit at any frequency between 500 kHz and 3 MHz from the channel edge should be:

$$\text{Spectrum shaping limit} \leq -(11.5 (|\Delta F| - 0.5) + 47) \text{ (dB}_{\text{DTV}}) \quad (5)$$

where:

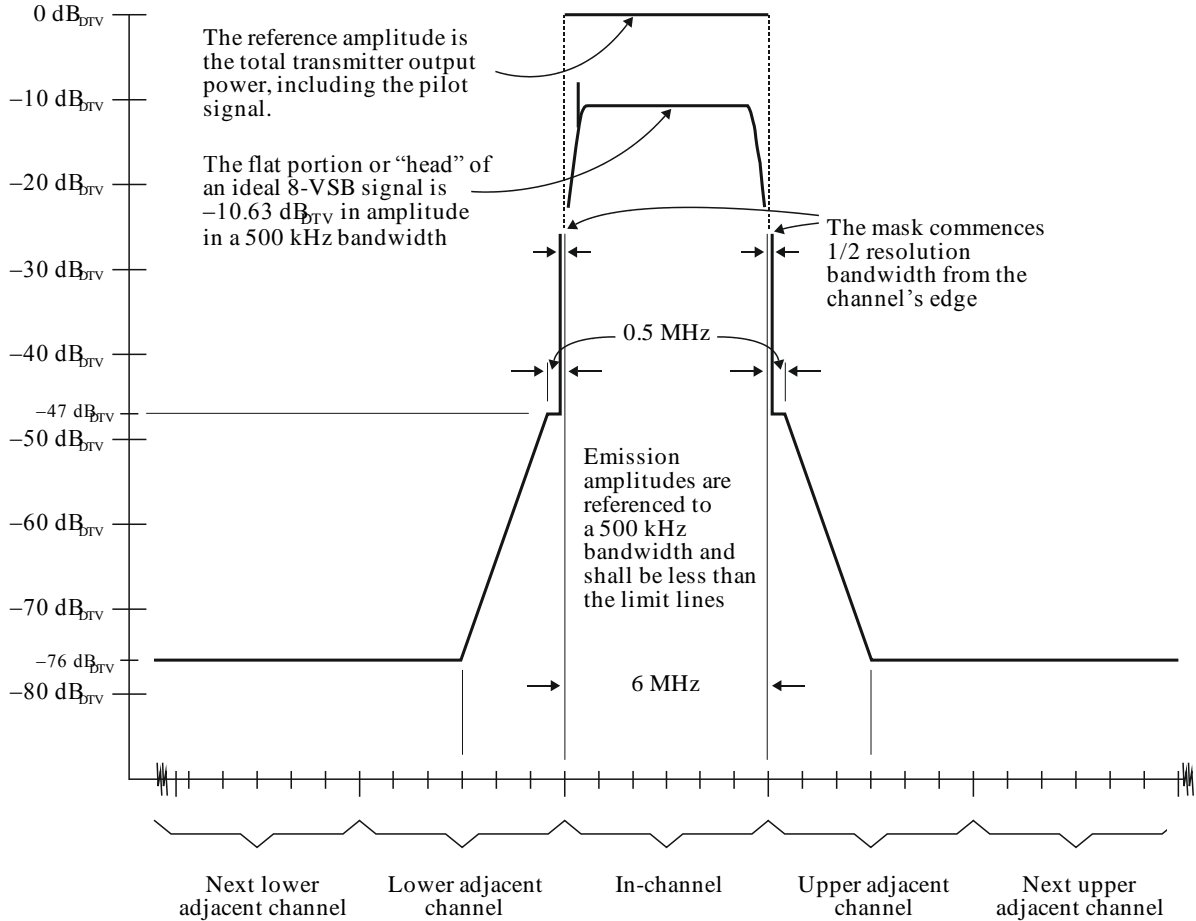
ΔF is the frequency difference, in MHz, from the channel edge.

- The spectrum shaping limit at any frequency more than 3 MHz from the channel edge should be:

$$\text{Spectrum shaping limit} \leq -76 \text{ dB}_{\text{DTV}} \tag{6}$$

The DTTB low power spectrum limit mask for LPTV transmitters and translators is illustrated graphically in Fig. 2.

FIGURE 2
Low power spectrum limit mask for 6 MHz 8-VSB LPTV transmitters and translators



BT.1206-2

3.3 Simple DTTB spectrum limit mask for LPTV transmitters and translators

- The spectrum shaping limit in the range between one-half of the width of the resolution bandwidth filter used and 6 MHz from the channel edge relative to the total transmitter output power should be:

$$\text{Spectrum shaping limit} \leq -((\Delta F^2/1.44) + 46) \text{ (dB}_{\text{DTV}}) \tag{7}$$

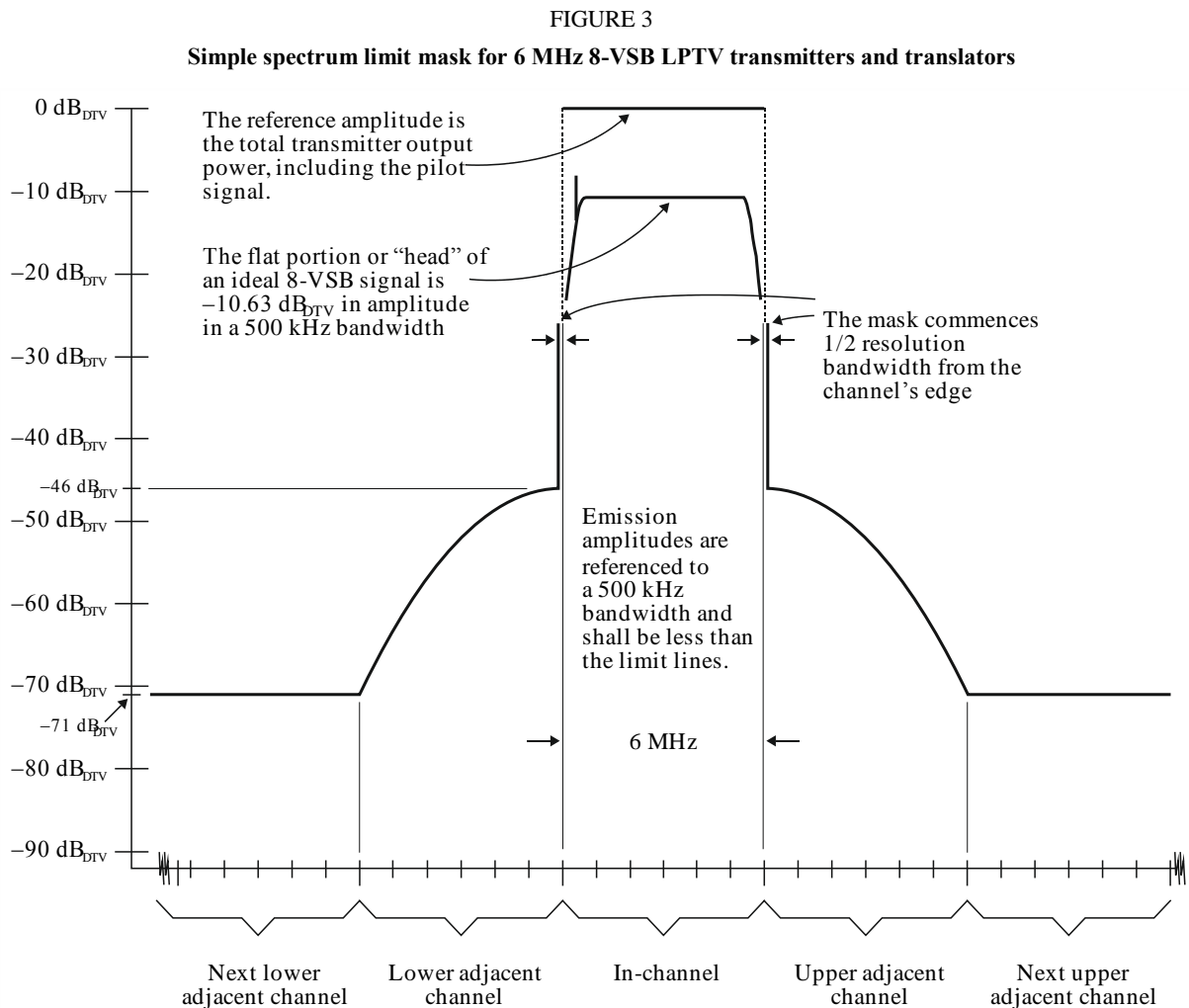
where:

ΔF is the frequency difference, in MHz, from the channel edge.

- The spectrum shaping limit at any frequency more than 6 MHz from the channel edge should be:

$$\text{Spectrum shaping limit} \leq -71 \text{ dB}_{\text{DTV}} \tag{8}$$

The DTTB simple spectrum limit mask for LPTV transmitters and translators is illustrated graphically in Fig. 3.



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Annex 2

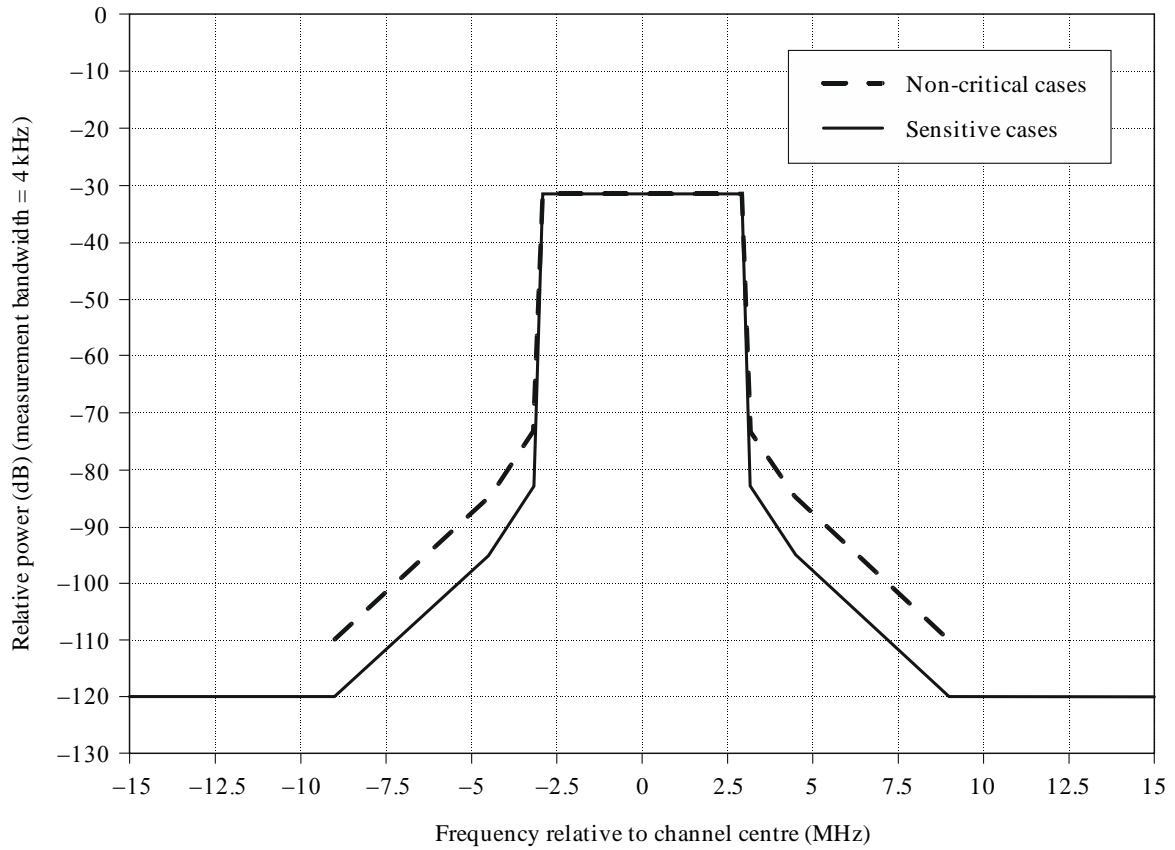
Specific spectrum limit masks for digital terrestrial television system B (DVB-T)

1 Specific spectrum limit masks for 6 MHz channelling system B (DVB-T)

For 6 MHz digital television, the OoB domain extends from $\pm 3.0 \text{ MHz}$ (i.e. $\pm 0.5 \times 6 \text{ MHz}$) to $\pm 15.0 \text{ MHz}$ (i.e. $\pm 2.5 \times 6 \text{ MHz}$) relative to channel centre.

Two spectrum masks are specified in Fig. 4 and the associated Table 1. The upper curve defines the spectrum mask for the non-critical cases and the lower curve defines the spectrum mask for the sensitive cases.

FIGURE 4
Spectrum limit masks for 6 MHz channelling system B (DVB-T)



BT.1206-4

TABLE 1

Table of break points corresponding to Fig. 4 for 6 MHz channelling system B (DVB-T)

Frequency relative to the centre of the 6 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)	
	Non-critical emission mask	Sensitive cases
-15.0	-110	-120
-9.0	-110	-120
-4.5	-85	-95
-3.15	-73	-83
-2.92	-31.6	-31.6
+2.92	-31.6	-31.6
+3.15	-73	-83
+4.5	-85	-95
+9.0	-110	-120
+15.0	-110	-120

2 Specific spectrum limit masks for 7 MHz channelling system B (DVB-T)

For 7 MHz digital television, the OoB domain extends from ± 3.5 MHz (i.e. $\pm 0.5 \times 7$ MHz) to ± 17.5 MHz (i.e. $\pm 2.5 \times 7$ MHz) relative to channel centre.

Two spectrum masks are specified in Fig. 5 and the associated Table 2. The upper curve defines the spectrum mask for the non-critical cases and the lower curve defines the spectrum mask for the sensitive cases.

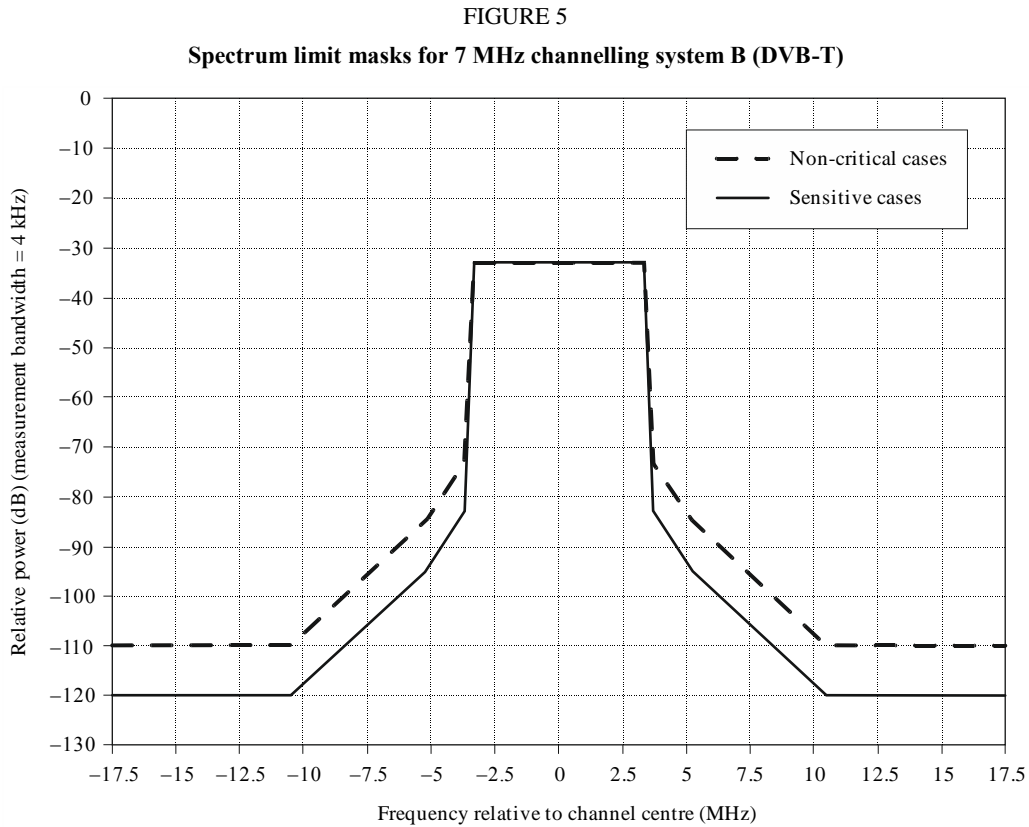


TABLE 2

Table of break points corresponding to Fig. 5 for 7 MHz channelling system B (DVB-T)

Frequency relative to the centre of the 7 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)	
	Non-critical emission mask	Sensitive cases
-17.5	-110	-120
-10.5	-110	-120
-5.25	-85	-95
-3.7	-73	-83
-3.35	-32.8	-32.8
+3.35	-32.8	-32.8
+3.7	-73	-83
+5.25	-85	-95
+10.5	-110	-120
+17.5	-110	-120

3 Specific spectrum limit masks for 8 MHz channelling system B (DVB-T)

For 8 MHz digital television, the OoB domain extends from ± 4 MHz (i.e. $\pm 0.5 \times 8$ MHz) to ± 20 MHz (i.e. $\pm 2.5 \times 8$ MHz) relative to channel centre.

Two spectrum masks are specified in Fig. 6 and the associated Table 3. The upper curve defines the spectrum mask for the non-critical cases and the lower curve defines the spectrum mask for the sensitive cases.

FIGURE 6
Spectrum limit masks for 8 MHz channelling system B (DVB-T)

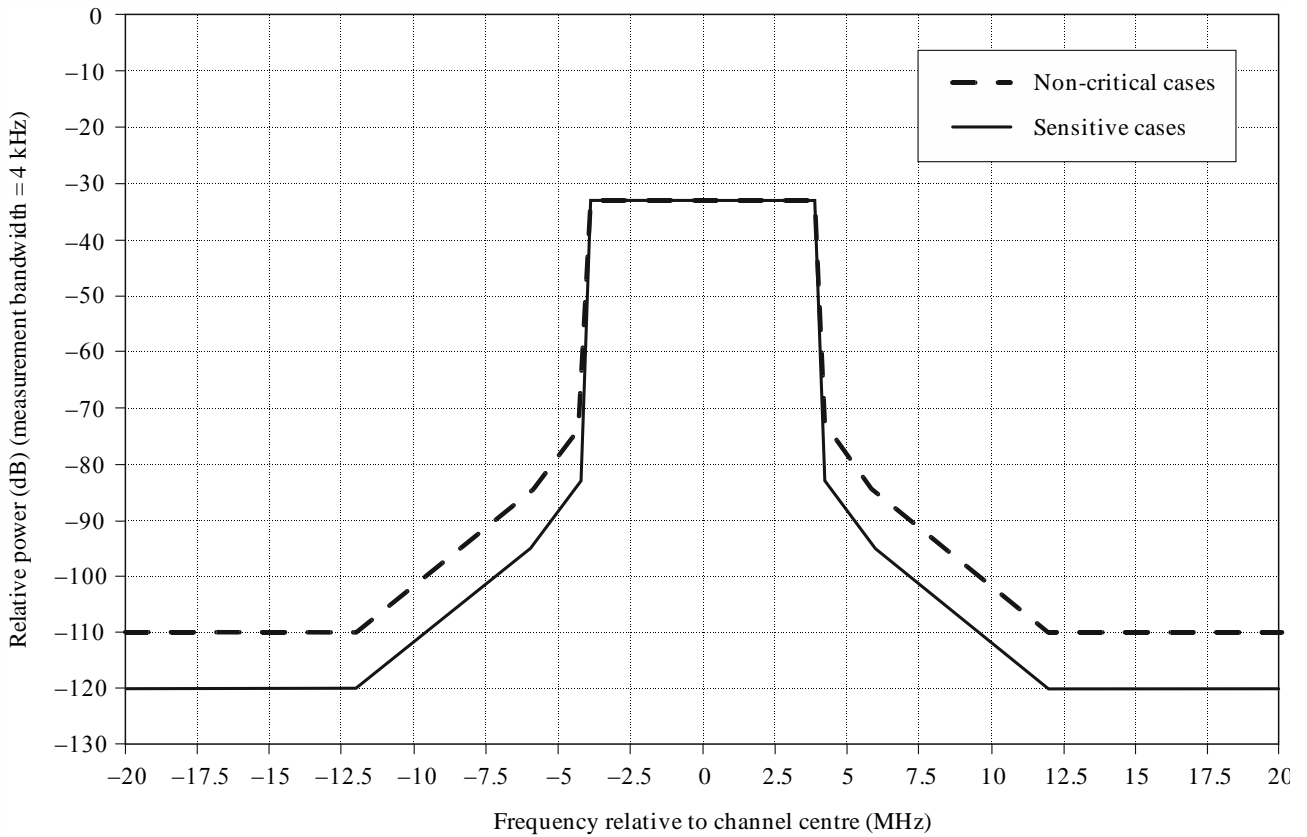


TABLE 3

Table of break points corresponding to Fig. 6 for 8 MHz channelling system B (DVB-T)

Frequency relative to the centre of the 8 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)	
	Non-critical emission mask	Sensitive cases
-20	-110	-120
-12	-110	-120
-6	-85	-95
-4.2	-73	-83
-3.9	-32.8	-32.8
+3.9	-32.8	-32.8
+4.2	-73	-83
+6	-85	-95
+12	-110	-120
+20	-110	-120

Annex 3

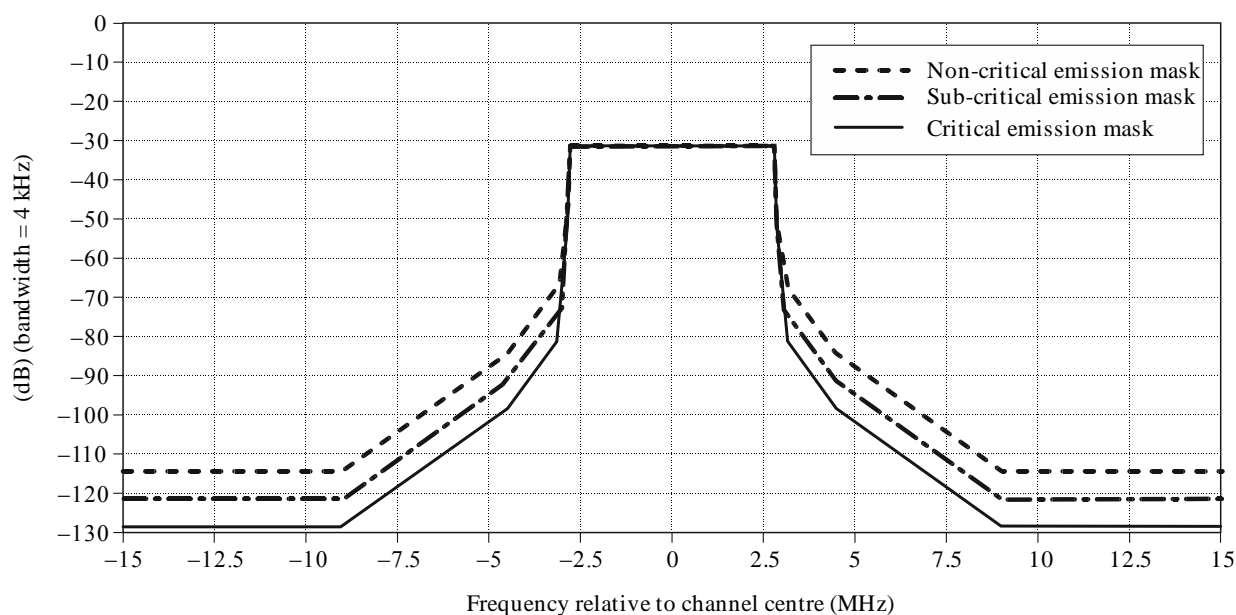
Specific spectrum limit masks for digital terrestrial television system C (ISDB-T)

1 Specific spectrum limit masks for 6 MHz channelling system C (ISDB-T)

For 6 MHz digital television, the OoB domain extends from ± 3 MHz (i.e. $\pm 0.5 \times 6$ MHz) to ± 15 MHz (i.e. $\pm 2.5 \times 6$ MHz) relative to channel centre.

Spectrum limit masks for 6 MHz channelling system C (ISDB-T) are shown in Fig. 7. The related break points are given in Table 4.

FIGURE 7
Spectrum limit masks for 6 MHz channelling system C (ISDB-T)



BT.1206-07

TABLE 4

Table of break points corresponding to Fig. 7 for 6 MHz channelling system C (ISDB-T)

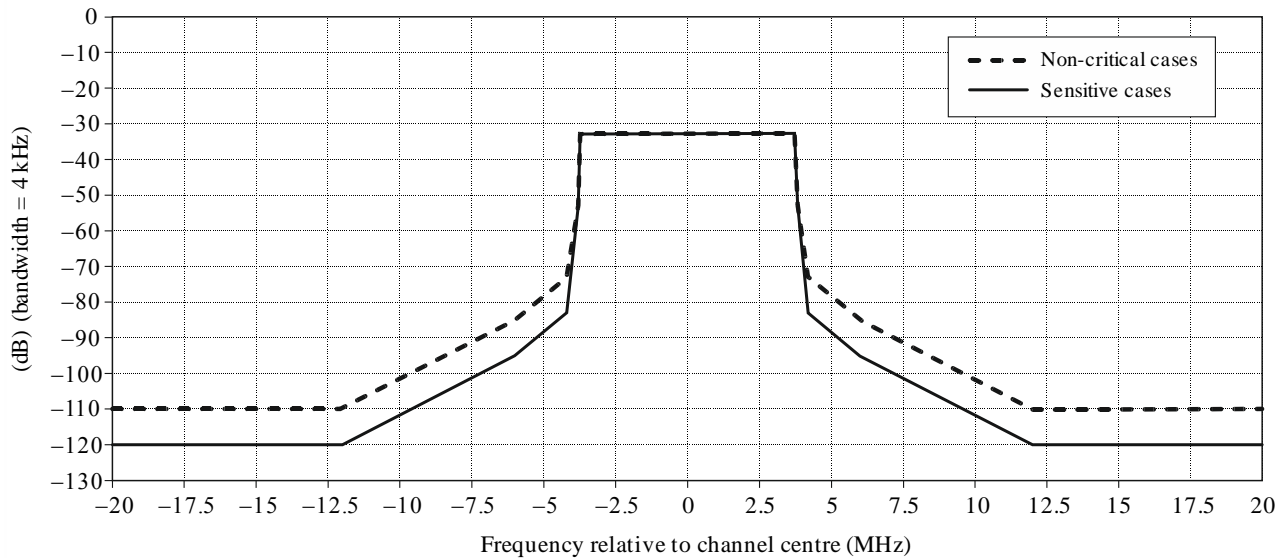
Frequency relative to the centre of the 6 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)		
	Non-critical emission mask	Sub-critical emission mask	Critical emission mask
-15	-114.4	-121.4	-128.4
-9	-114.4	-121.4	-128.4
-4.5	-84.4	-91.4	-98.4
-3.15	-67.4	-74.4	-81.4
-3	-58.4	-65.4	-65.4
-2.86	-51.4	-51.4	-51.4
-2.79	-31.4	-31.4	-31.4
2.79	-31.4	-31.4	-31.4
2.86	-51.4	-51.4	-51.4
3	-58.4	-65.4	-65.4
3.15	-67.4	-74.4	-81.4
4.5	-84.4	-91.4	-98.4
9	-114.4	-121.4	-128.4
15	-114.4	-121.4	-128.4

2 Specific spectrum limit masks for 7 MHz channelling system C (ISDB-T)

For 7 MHz digital television, the OoB domain extends from ± 3.5 MHz (i.e. $\pm 0.5 \times 7$ MHz) to ± 17.5 MHz (i.e. $\pm 2.5 \times 7$ MHz) relative to channel centre.

Two spectrum masks are specified in Fig. 8 and the associated Table 5. The upper curve defines the spectrum mask for the non-critical cases and the lower curve defines the spectrum mask for the sensitive cases.

FIGURE 8
Spectrum limit masks for 7 MHz channelling system C (ISDB-T)



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TABLE 5

Table of break points corresponding to Fig. 8 for 7 MHz channelling system C (ISDB-T)

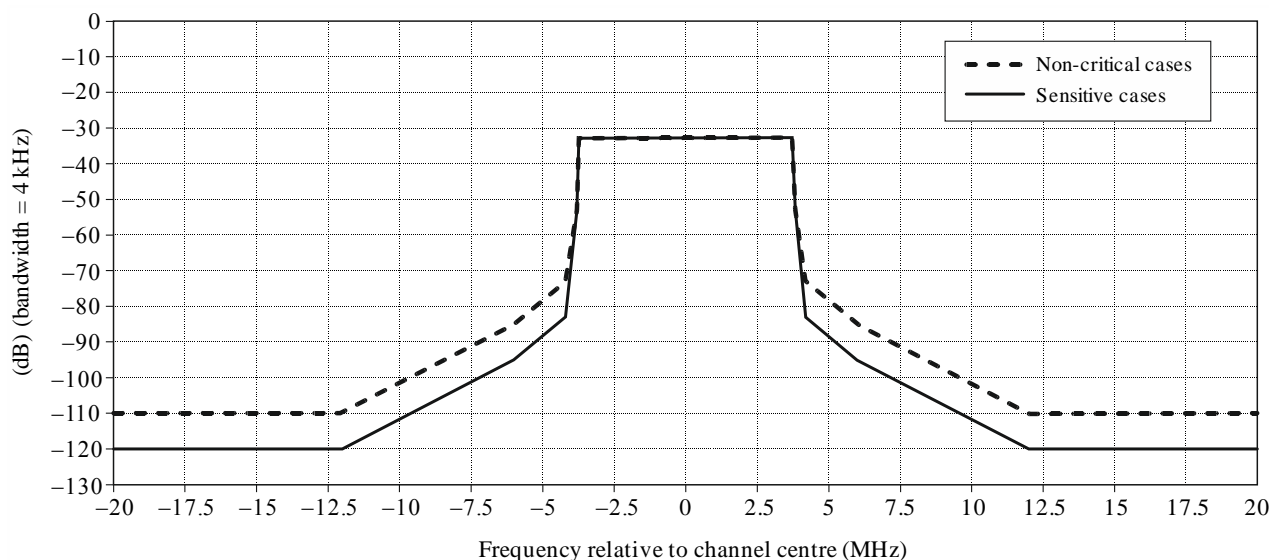
Frequency relative to the centre of the 7 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)	
	Non-critical emission mask	Sensitive cases
-17.5	-110	-120
-10.5	-110	-120
-5.25	-85	-95
-3.7	-73	-83
-3.34	-52.1	-52.1
-3.26	-32.1	-32.1
+3.26	-32.1	-32.1
+3.34	-52.1	-52.1
+3.7	-73	-83
+5.25	-85	-95
+10.5	-110	-120
+17.5	-110	-120

3 Specific spectrum limit masks for 8 MHz channelling system C (ISDB-T)

For 8 MHz digital television, the OoB domain extends from ± 4 MHz (i.e. $\pm 0.5 \times 8$ MHz) to ± 20 MHz (i.e. $\pm 2.5 \times 8$ MHz) relative to channel centre.

Two spectrum masks are specified in Fig. 9 and the associated Table 6. The upper curve defines the spectrum mask for the non-critical cases and the lower curve defines the spectrum mask for the sensitive cases.

FIGURE 9
Spectrum limit masks for 8 MHz channelling system C (ISDB-T)



BT.1206-05

TABLE 6

Table of break points corresponding to Fig. 9 for 8 MHz channelling system C (ISDB-T)

Frequency relative to the centre of the 8 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)	
	Non-critical emission mask	Sensitive cases
-20	-110	-120
-12	-110	-120
-6	-85	-95
-4.2	-73	-83
-3.81	-52.7	-52.7
-3.72	-32.7	-32.7
+3.72	-32.7	-32.7
+3.81	-52.7	-52.7
+4.2	-73	-83
+6	-85	-95
+12	-110	-120
+20	-110	-120

Annex 4

Specific spectrum limit mask for digital terrestrial television system D (DTMB)

1 Specific spectrum limit masks for 6 MHz channelling system D (DTMB)

For 6 MHz digital television, the OoB domain extends from ± 3 MHz (i.e. $\pm 0.5 \times 6$ MHz) to ± 15 MHz (i.e. $\pm 2.5 \times 6$ MHz) relative to channel centre.

Two spectrum masks are specified in Fig. 10 and the associated Table 7. The upper curve defines the spectrum mask for the non-sensitive cases and the lower curve defines the spectrum mask for the sensitive cases.

FIGURE 10
Spectrum limit masks for 6 MHz channelling system D (DTMB)

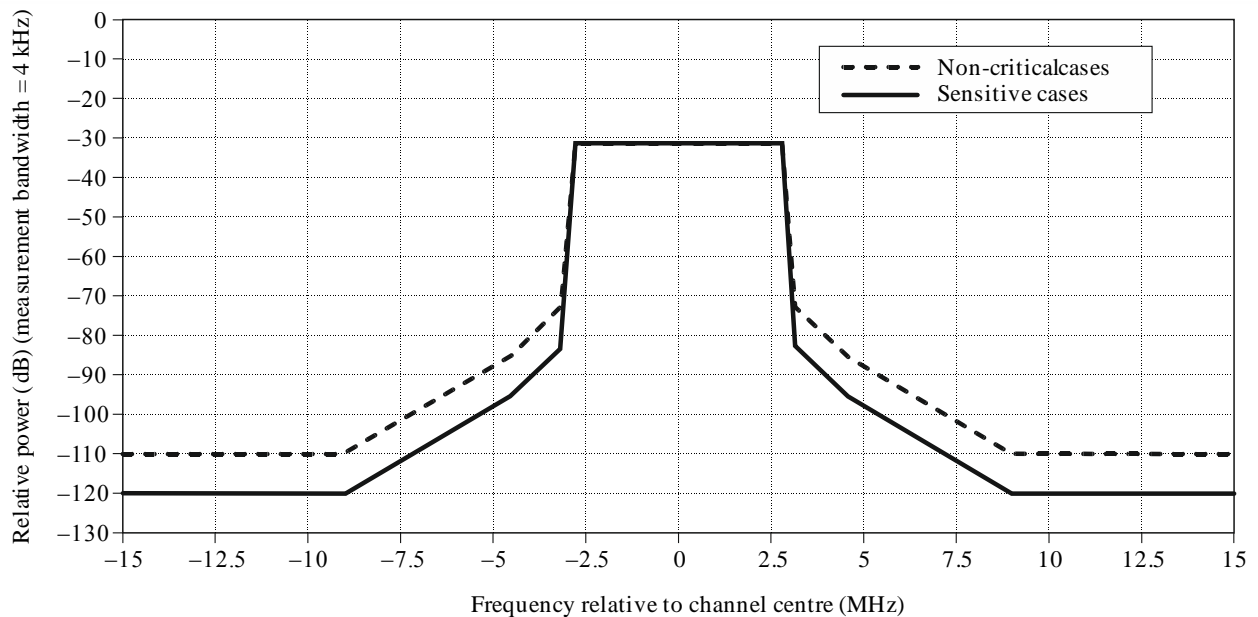


TABLE 7

Table of break points corresponding to Fig. 10 for 6 MHz channelling system D (DTMB)

Frequency relative to the centre of the 8 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)	
	Non-critical emission mask	Sensitive cases
-15	-110	-120
-9	-110	-120
-4.5	-85	-95
-3.15	-73	-83
-2.85	-31.4	-31.4
2.85	-31.4	-31.4
3.15	-73	-83
4.5	-85	-95
9	-110	-120
15	-110	-120

2 Specific spectrum limit masks for 7 MHz channelling system D (DTMB)

For 7 MHz digital television, the OoB domain extends from ± 3.5 MHz (i.e. $\pm 0.5 \times 7$ MHz) to ± 17.5 MHz (i.e. $\pm 2.5 \times 7$ MHz) relative to channel centre.

Two spectrum masks are specified in Fig. 11 and the associated Table 8. The upper curve defines the spectrum mask for the non-sensitive cases and the lower curve defines the spectrum mask for the sensitive cases.

FIGURE 11

Spectrum limit masks for 7 MHz channelling system D (DTMB)

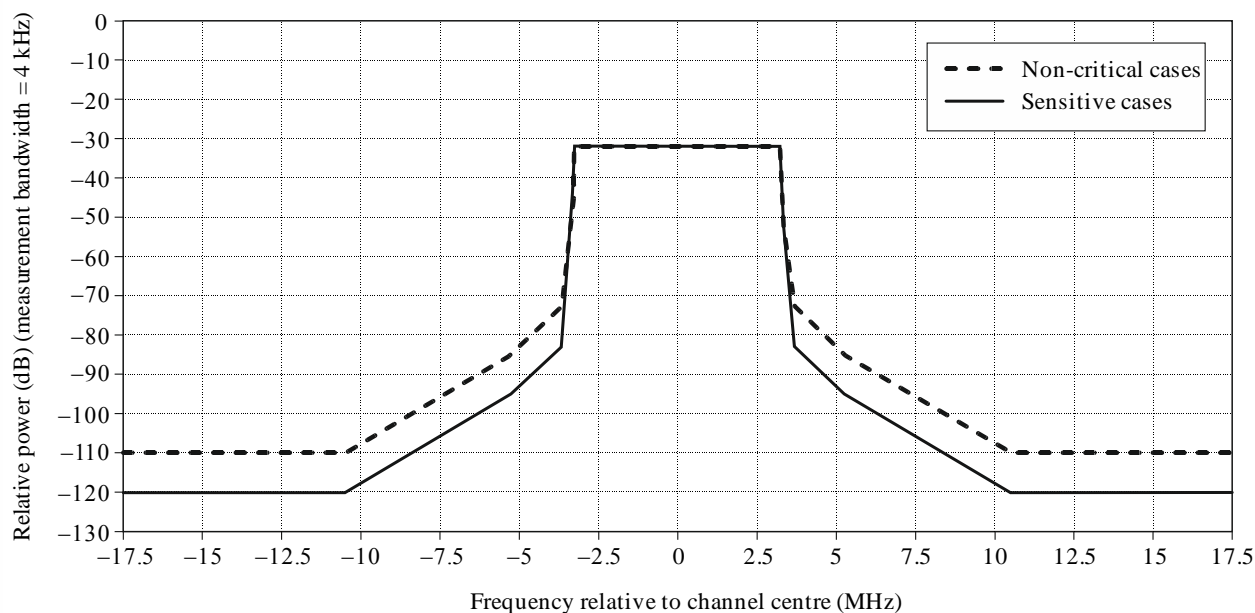


TABLE 8

Table of break points corresponding to Fig. 11 for 7 MHz channelling system D (DTMB)

Frequency relative to the centre of the 7 MHz channel (MHz)	Relative level in a 4 kHz measurement bandwidth (dB)	
	Non-critical emission mask	Sensitive cases
-17.5	-110	-120
-10.5	-110	-120
-5.25	-85	-95
-3.7	-73	-83
-3.33	-32.1	-32.1
+3.33	-32.1	-32.1
+3.7	-73	-83
+5.25	-85	-95
+10.5	-110	-120
+17.5	-110	-120

3 Specific spectrum limit masks for 8 MHz channelling system D (DTMB)

When the digital system operates on a lower or higher adjacent channel to a co-sited transmitter, the spectrum limit mask of system D with 8 MHz channel spacing for different application scenarios are given by Figs 12 and 13. Detailed data of Figs 12 and 13 were presented by Tables 9 and 10, respectively.

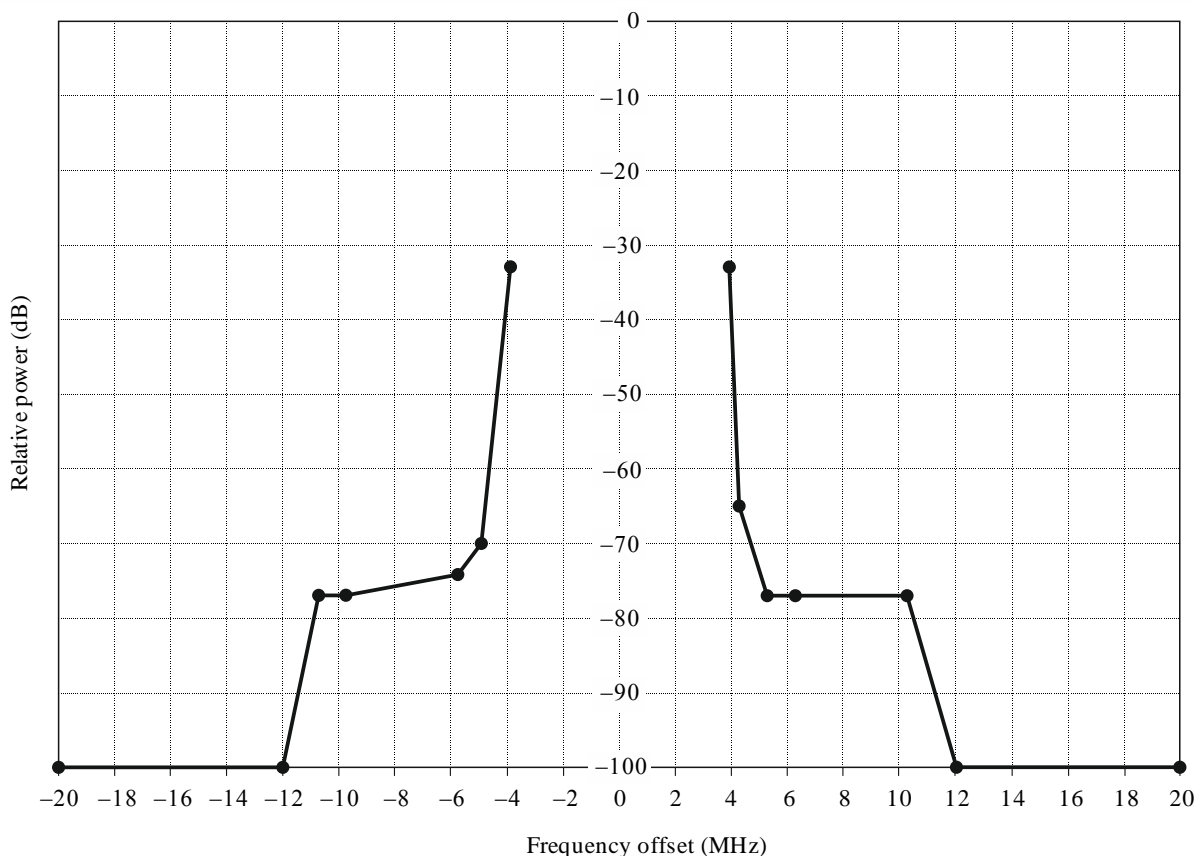
The masks shown in Fig. 12 show the minimum protection needed for analogue television where the analogue and the digital television transmitters are co-sited and are applicable for cases where:

- no polarization discrimination between digital and analogue television is used; and
- the radiated power from both transmitters is the same (analogue sync-peak power equal to total power from the digital television transmitter). If the radiated powers from the two transmitters are not identical, proportional correction can be applied as follows:

$$\text{correction} = \text{minimum analogue erp} - \text{maximum digital erp.}$$

FIGURE 12

Spectrum limit mask when DTMB transmitter with 8 MHz channel spacing operates on a lower or higher adjacent channel to a co-sited analogue television transmitter (measured with 4 kHz bandwidth)



BT.1206-12

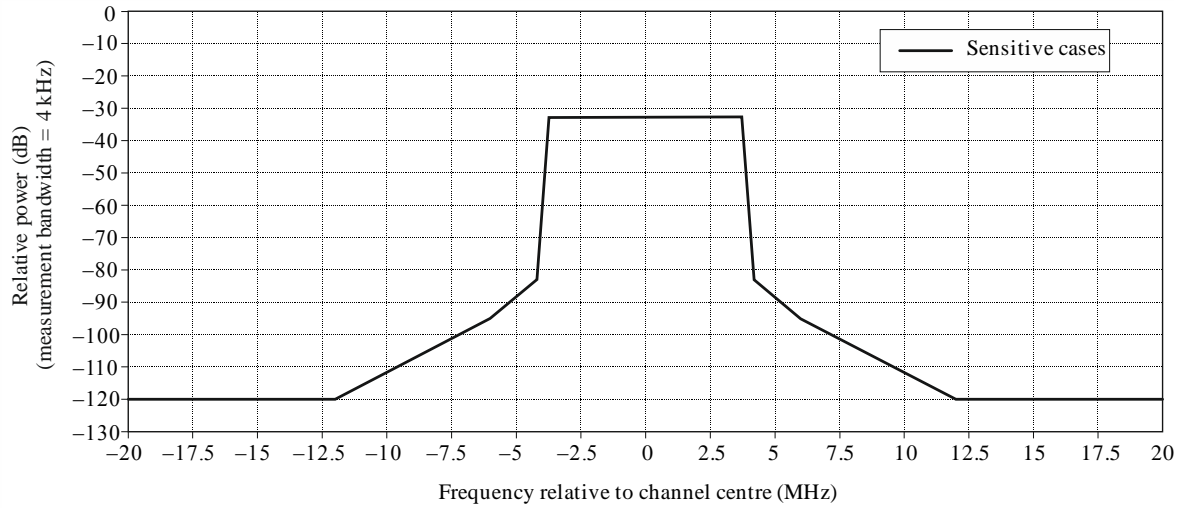
TABLE 9

Breakpoints of the spectrum limit mask when DTMB transmitter with 8 MHz channel spacing operates on a lower or higher adjacent channel to a co-sited analogue television transmitter (measured with 4 kHz bandwidth)

Frequency offset to the central frequency (MHz)	Relative level (dB)
-20	-100
-12	-100
-10.75	-76.9
-9.75	-76.9
-5.75	-74.2
-4.94	-69.9
-3.9	-32.8
+3.9	-32.8
+4.25	-64.9
+5.25	-76.9
+6.25	-76.9
+10.25	-76.9
+12	-100
+20	-100

FIGURE 13

Spectrum limit mask for sensitive cases when DTMB transmitter with 8 MHz channel spacing operates on a lower or higher adjacent channel to other services (e.g. with low power) (measured with 4 kHz bandwidth)



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TABLE 10

Breakpoints of the spectrum limit mask for sensitive cases when DTMB transmitter with 8 MHz channel spacing operates on a lower or higher adjacent channel to other services (e.g. with low power) (measured with 4 kHz bandwidth)

Frequency offset related to the central frequency (MHz)	Relative level (dB)
-20	-120
-12	-120
-6	-95
-4.2	-83
-3.8	-32.8
+3.8	-32.8
+4.2	-83
+6	-95
+12	-120
+20	-120