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(07/2019)

Characteristics of digital terrestrial broadcasting systems in the frequency band 174-230 MHz

BT Series

Broadcasting service (television)

International Telecommunication Union

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REPORT ITU-R BT.2469-0

Characteristics of digital terrestrial broadcasting systems in the frequency band 174-230 MHz

(2019)

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1 Introduction

This Report contains a summary of the reference technical and operational characteristics of Band III (174-230 MHz) digital terrestrial broadcasting (DTB) systems, television and sound, required for relevant sharing studies in Regions 1, 2 and 3.

Quotes from existing text in ITU-R are highlighted through the use of *Italics*.

It should be noted that for Band I, II, III, IV and V systems broadcasters quote antenna gains and effective radiated power (ERP) relative to a dipole. So, for example, a DTT receive antenna with a quoted gain of 7 dB has a gain of 9.15 dBi when referenced to an isotropic source. Also, a broadcast station with a quoted ERP of 20 kW (43 dBW) has an e.i.r.p. of 75.15 dBm.

2 Broadcasting description

2.1 Broadcasting protection criteria

Broadcasting protection criteria are based on local interference considerations such as reception location probability, degradation to reception location probability in the presence of additional interference, I/N limitation and degradation to C/N.

Details about the protection requirements for the broadcasting service can be found in particular in Recommendation ITU-R BT/BS.1895 – Protection criteria for terrestrial broadcasting systems, and Report ITU-R BT.2265 – Guidelines for the assessment of interference into the broadcasting service. Further references are listed in Annex 1.

2.2 Broadcast service requirements

Terrestrial broadcasting services are required by many administrations to cover a high percentage of the population/households (e.g. 98%) or geographic regions (e.g. the entire country), in accordance with statutory requirements or commercial agreements. Reception in the area defined by this coverage requirement is stipulated for continuous use, for a specified time availability[1], within the hours of transmission. This coverage requirement (as distinct from the coverage area of the broadcast transmission) applies within the service area that is licensed and protected.

Within the broadcast service area, interference effects can be assessed in many ways, but the overriding issue is how they may translate in terms of reducing the ability of the serving station or network to meet the coverage requirement of the broadcasting service. A reduction in the ability to meet the coverage requirement effectively translates to a loss of access to broadcast receiving stations for the specified time availability. Broadcast service planning methods are based on meeting a prescribed coverage requirement.

In cases where interference is from a distant source(s) outside the service area – typically, because of the distance such interference is co-channel – interference can usually be assessed in terms of limits on I/N only.

In cases where interference is from a source or sources within the service area – typically, because of the distance, adjacent-channel interference – interference can be initially assessed in terms of limits on I/N. However, in this case when calculating I/N a minimum distance, between the interferer and victim receiver, needs to be specified, which could be, for example - the distance associated with the minimum coupling loss.

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[1] Time availability in this case refers to the time that a service is not subject to interference due to enhanced propagation conditions.

Where further analysis is required, the impact to coverage of interference is normally assessed in terms of reception location probability. In such cases a judgement has to be made as to the acceptable reduction in area or population that, as a result of interference, can no longer receive a service for the specified time. What constitutes an acceptable reduction in service will depend on the statutory requirements and commercial agreements applicable to the affected service.

Specifically, the broadcast service delivery to the target population within the broadcast service area has been based on the expectation of a signal quality with minimum interruption[2].

2.3 Assessment of interference impact on the broadcast coverage

2.3.1 Introduction

To assess the impact of interference into broadcast networks, it is necessary to apply the broadcast planning criteria with the new level of interference and compare the relative change in quality of service requirement before and after the introduction of the new source of interference. The issues that arise from the combination of this process and sharing studies are highlighted in § 2.3.2.

2.3.2 Standard broadcast planning practice

Planning of a digital terrestrial broadcasting service is based on specified parameters and requirements and providing a service that is quasi-error-free (QEF). These elements form the basis for the protection of the existing digital terrestrial broadcast networks.

A QEF condition of a digital television broadcasting signal means less than one uncorrected error event per hour and a corresponding BER can be calculated for an assumed transmission bit rate. For example, for a DTTB transmission with a bit rate of about 28 Mbit/s, QEF corresponds to BER less than 10^{-11} after the whole error correction process.

Which in the case of:

– DVB-T, ATSC1.0 and ISDB-T, this corresponds to BER less than 2×10^{-4} after Viterbi decoder or BER less than 10^{-11} after Reed-Solomon decoder.

– DVB-T2, DTMB and DTMB-A, this corresponds to BER less than 10^{-7} before BCH decoder or BER less than 10^{-11} after BCH decoder.

Any study of interference into a DTTB system must take account of QEF and the hour time window. For planning terrestrial broadcasting services, it is important to take into consideration the different elements of interference and the implications of temporal variations to separately identify when interference into the broadcast service arises from protection ratio failure and blocking due to overloading.

Spectrum planners are aware that a relaxation in the value or exclusion of certain interference assessment factors would reduce the ability to meet the broadcast coverage quality requirement. A relaxation of more than one of these parameters could result in a significant cumulative reduction in the extent to which a service area can be covered.

In the simple conceptual example below of planning the broadcasting service, it is assumed that the area covered by the broadcast transmission is circular and that up to four of the above interference assessment factors have been relaxed. Each reduction in the level of protection afforded by one of the broadcast interference assessment factors is represented by a ring identifying the potential percentage of the existing population or country that can no longer be reached under the broadcast coverage requirement, because of interference arising from the relaxation in the interference assessment factor(s).

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[2] Refer to Recommendations ITU-R BT.500, ITU-R BT.1735 and ITU-R BS.1284.

A simplification of the spectrum planning process[3] is provided for illustrative purposes in the diagram below. A service area with an existing broadcast provision that has been planned in accordance with the broadcast planning criteria and meets or exceeds the prescribed coverage requirement is represented in Fig. 1A by the dotted circle. That part of the service area in Fig. 1A, where the planned broadcast coverage has been reduced or lost due to the level of the interfering signal arising from the relaxation in one of the interference assessment factor(s) is shown in Fig. 1B.

In Fig. 1C the relaxation of multiple (in this case 4) interference assessment factors is aggregated to show the consequential impact on the planned broadcast service area, with the dotted area the only part of the planned broadcast service area in Fig. 1A, that remains covered by the planned broadcast transmission parameters. Not only is the effective broadcast service area significantly reduced but the target population within the planned service area is no longer served.

FIGURE 1A

Original area covered

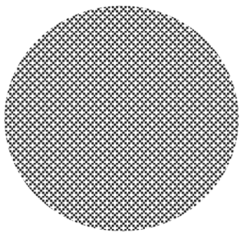


FIGURE 1B

Reduction in area covered (relaxation of one factor)

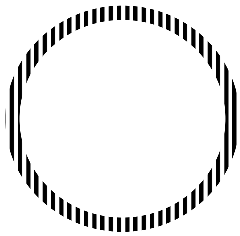
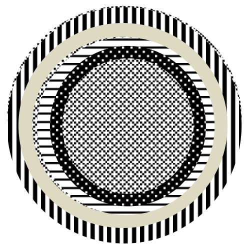


FIGURE 1C

Resulting area covered (relaxation of four factors)



In practice a broadcast service area is unlikely to be circular and the population lost to broadcast coverage will not be located in convenient rings around the edge of that service area. Both areas will be influenced by topographical factors, population distribution and the respective locations of the wanted and interfering transmitters.

Transmissions in adjacent bands /channels may also cause interference. Recommendations ITU-R BT.1368, ITU-R BT.2033 and ITU-R BS.1660 as well as Reports ITU-R BT.2215 and ITU-R BT.2248 contain additional information on this case.

2.4 Propagation considerations for interference assessments

Broadcast planning is based on the service being subject to occasional very limited outages during the year. Indeed, many administrations have followed this and other principles established in the DTTB Handbook – Digital terrestrial television broadcasting in the VHF/UHF bands – and the DSB Handbook – Terrestrial and satellite digital sound broadcasting to vehicular, portable and fixed receivers in the VHF/UHF bands – in achieving global harmonization of terrestrial television and sound broadcasting systems. The protection criteria established in Recommendations ITU-R BT.1368 and ITU-R BT.2033 for protecting DTTB services and in ITU-R BS.1660 for DSB have been developed on the assumption that Recommendation ITU-R P.1546 is used in interference assessment and it is essential to take this into consideration. It should be noted that Recommendation ITU-R P.1546 has been the recommended propagation model for terrestrial television broadcast planning for over a decade. Application of a different propagation model for DTTB and DSB coverage/interference assessment may not necessarily be compatible with the planning criteria and protection ratios applied by administrations towards maintaining the required quality of coverage.

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[3] Refer to Report ITU-R BT.2248.

Administrations which currently have planned digital terrestrial broadcasting services are aware that, like several other radio communication services, interference assessment is based on an interfering signal exceeding an annual 1% of time limit based upon a methodology that includes Recommendation ITU-R P.1546.

2.5 Aggregation of interference

Appendix 3 to Annex 2 to Report ITU-R BT.2265-2 describes the methods for the aggregation of short-term interfering signals.

Two methods for the computation of aggregate interference from multiple transmitters where individual path losses are temporally variable are recommended.

The first approach ("general method") is based on a rigorous mathematical treatment of the joint variability of multiple paths, and can be used to estimate the aggregate received power at any percentage-time. The method uses Monte Carlo simulation involving multiple calculations for each path of interest, and would be appropriate for use in a situation where numerically-intensive computer simulation is already envisaged.

Recognizing that this approach may not always be appropriate (e.g. where a quick estimate is required without an iterative computer simulation), a simple alternative is also proposed ("simple method"). This method is currently only defined for the case where the aggregate power is to be estimated at 1% time, although it could be readily extended for use at other percentage-times.

2.6 Comparative evaluations

When calculations are carried out with certain reference parameters and comparison calculations are to be carried out, the relevant reference parameters must be the same. For example, if single-entry field strength values are calculated at a 10 m DTB receive antenna height, then comparison multiple-entry field values should also be calculated at the same 10 m DTB receive antenna height.

2.7 Inclusion of noise in interference assessments

An important factor in terrestrial broadcast service planning is the need to take into consideration an allowance for the noise environment in which the terrestrial broadcast service is to be planned – these are rural, urban and suburban. It should also be noted that broadcast services are planned based upon the calculation of C/N prior to the introduction and deployment of other services which has the potential to increase the noise allowance calculation required in many environments.

A wanted broadcast signal must be sufficient to overcome noise for it to be receivable and in this respect thermal noise and noise figure are an essential part of any calculations. These are the fundamentals upon which the broadcast receivers deployed globally have been designed.

3 Television Systems

This section provides parameters for Band III television systems for use in sharing and compatibility studies. Section 3.1 provides transmission parameters, Section3.2 provides receiver parameters. Common parameters are provided at the start of each of these sections with sub-sections containing parameters specific to a given television technology, DVB-T/T2, ATSC, ISDB-T, and DTMB.

3.1 Television transmission parameters for use in sharing and compatibility studies

3.1.1 DTTB System B (DVB-T) reference broadcasting networks

Reference broadcast transmitter configurations are provided that are representative of actual deployments in the case of assignments. Information on the reference configurations used in the GE06 Agreement for allotment planning are provided in Annex 3.

3.1.1.1 DVB-T and DVB-T2 Single transmitter case (assignments):

– High power
  - ERP: 20 kW
  - Effective antenna height: 300 m
  - Antenna height a.g.l.: 100 m
  - Antenna pattern:
    - Horizontal: Omnidirectional
    - Vertical antenna aperture: based on 12λ aperture with 2° beam tilt

– Medium power
  - ERP: 2 kW
  - Effective antenna height: 150 m
  - Antenna height a.g.l.: 50 m
  - Antenna pattern:
    - Horizontal: Omnidirectional
    - Vertical: based on 6λ aperture with 3.2° beam tilt

– Low power
  - ERP: 250 W
  - Effective antenna height: 50 m
  - Antenna height a.g.l.: 20 m
  - Antenna pattern:
    - Horizontal: Directional (cardioid)
    - Vertical: based on 4λ aperture with 6° beam tilt

The attenuation (A_ϑ) of the horizontal radiation pattern with azimuth angle (ϑ) is given by:

$$A_\vartheta = 20\log_{10}(2B - B^2)\ \text{dB}$$

where:

$$B = \frac{1 + k + \cos(\vartheta)}{2 + k}$$

where:

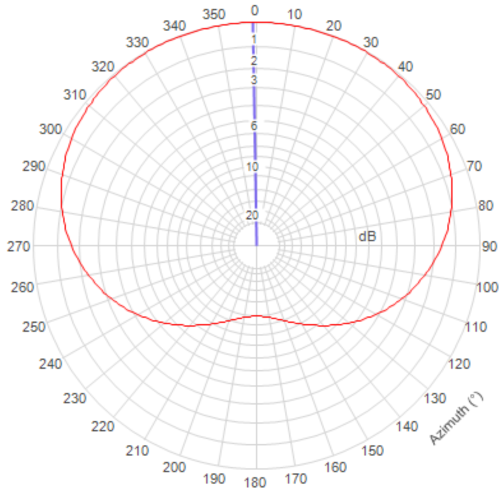
ϑ : azimuth angle

k : 0.4187 for 10 dB pattern minima.

The resulting pattern is shown in Fig. 2:

FIGURE 2

Low power DTT



Unlike high and medium power antennas which are usually omnidirectional, few low power DTT antenna are omnidirectional. Low power DTT antennas typically have a directional horizontal radiation pattern usually of a type cardioid (dipoles mounted on a pole) or consisting of one or more panel, Yagi or log-periodic elements. These antennas typically have minima in the HRP that are 10 dB or more below the maximum and may have lobes that occur at various azimuth angles, lobes typically being aligned with the desired service area.

As patterns of low power antenna vary considerably modelling all combinations of pattern in generic compatibility studies is usually not practical. Therefore, to better represent the horizontal radiation pattern of low power DTT it is proposed to base the generic model on the pattern of a cardioid antenna with a 10 dB minimum. Depending on the compatibility study being undertaken the orientation of the pattern (angle of azimuth) can be varied as required.

3.1.1.2 Vertical radiation patterns

The normalized field strength in the vicinity of the broadcast transmitting station is a function of the vertical radiation pattern of the transmitting antenna. The equation below is an approximation to be used for sharing studies.

$$E(\theta) = abs\left(\frac{\sin\psi}{\psi}\right)$$

where:

$$\Psi = \pi A \sin(\theta - \beta)$$

and

A = the antenna vertical aperture in wavelengths

β = the beam tilt radians below the horizontal.

To allow for null fill the value of $E(\theta)$ should not go below the value shown in Table 1.

TABLE 1

Null fill values to be applied to vertical radiation patterns

	Limit on $E(\theta)$
First null	0.15
Second null	0.1

For the third null and at all angles of θ beyond the third null the value of $E(\theta)$ should not fall below 0.05.

$E(\theta)$ given above are linear values, to convert them to reduction values in dB the following equation is used:

$$Reduction\ in\ dB = 20 * log10\{E(\theta)\}$$

3.1.1.3 Out of Band Mask

Out-of-band (OOB) emission limits of DVB-T/T2 transmitters for use in compatibility studies are based on ETSI EN 302 296[4].

Out-of-band emissions limits are given as mean power level measured at the antenna port in a 3 kHz bandwidth for the non-critical (Table 2 and Figure 3) and critical (Table 4 and Figure 4) masks. It should be noted that for transmitters above 25 W these are the same as the GE06 masks but referenced to a 3 kHz not 4 kHz measurement bandwidth and they extend to ±17.5 MHz not ±10.5 MHz.

Transmitters ≤25 W are subject to different limits Tables 3 and 5 for non-critical and critical cases respectively.

TABLE 2

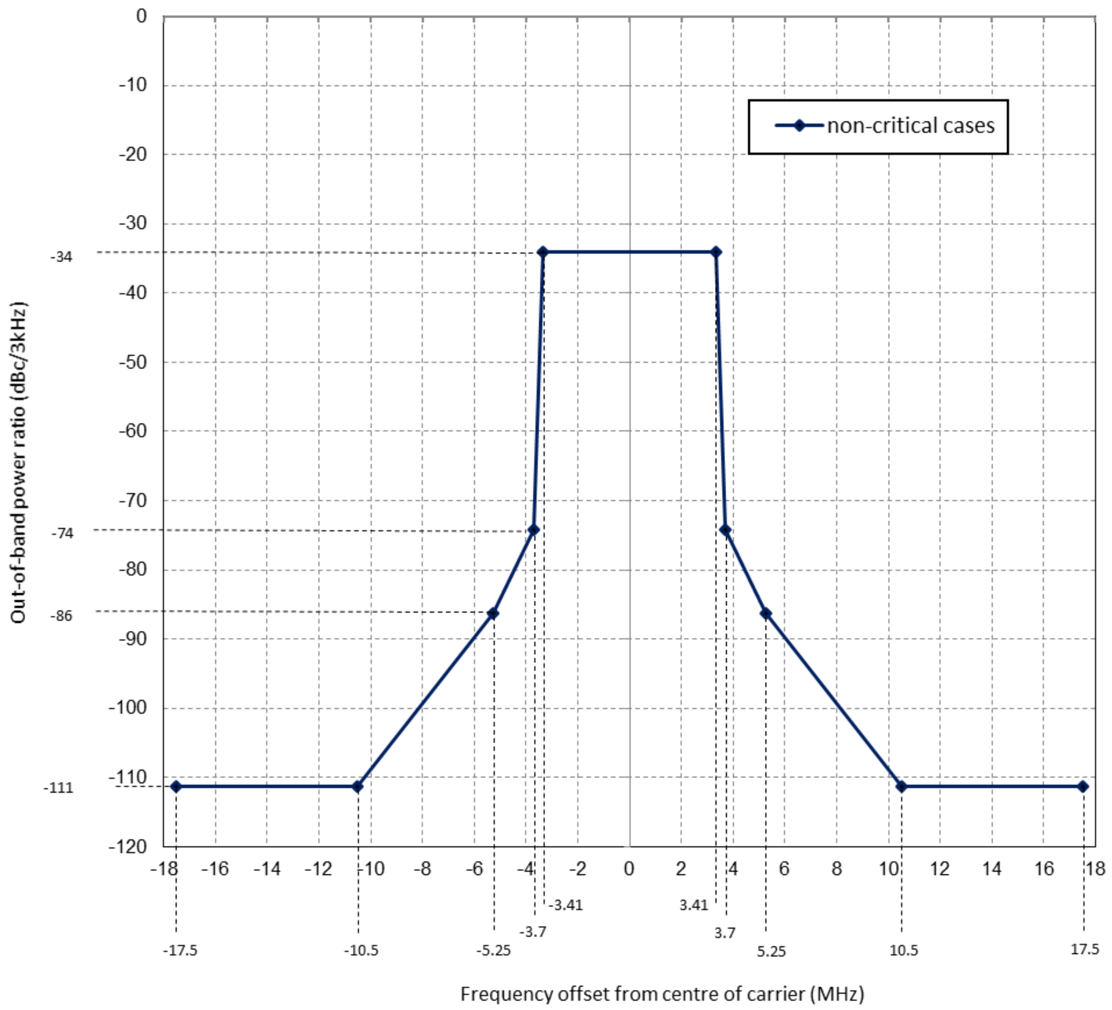
OOB emission limits for DVB-T/T2 transmitter >25 W non-critical

Classification	**7 MHz Channel, frequency difference from the centre frequency (MHz)**	**Relative level (dBc/3kHz)**
Non-critical cases	±3,41	–34
	±3,7	–74
	±5,25	–86
	±10,5	–111
	±17,5	–111

4 ETSI EN 302 296v2.1.1 (2017-6), “Digital Terrestrial TV Transmitters; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU”.

FIGURE 3

Non-critical OOB limits for DVB-T/T2 transmitters > 25 W in 7 MHz channels



Non-critical OOB limits for a low-power DTT system (≤25W) should conform to the ACLR limits provided in Table 5.

TABLE 3

Non-critical ACLR limits (dB) for 7 MHz DVB-T / T2 transmitters ≤25W, for 1st adjacent victim channels

		DVB-T/DVB-T2	DVB-T/DVB-T2
Power (watts)	**Power (dBm)**	**ACLR (dB) 1st adjacent channel**	**ACLR (dB) 2nd Adjacent channel**
≤25	≤44.0	42	64

TABLE 4

OOB emission limits for DVB-T/T2 transmitter >25 W critical

Classification accordingly the frequency assignment	7 MHz Channel, frequency difference from the centre frequency (MHz)	Relative level (dBc/3kHz)
Critical cases	±3.41	–34
	±3.7	–84
	±5.25	–96
	±10.5	–121
	±17.5	–121

FIGURE 4

Critical OOB limits for DVB-T/T2 transmitters >25 W 7 MHz channels

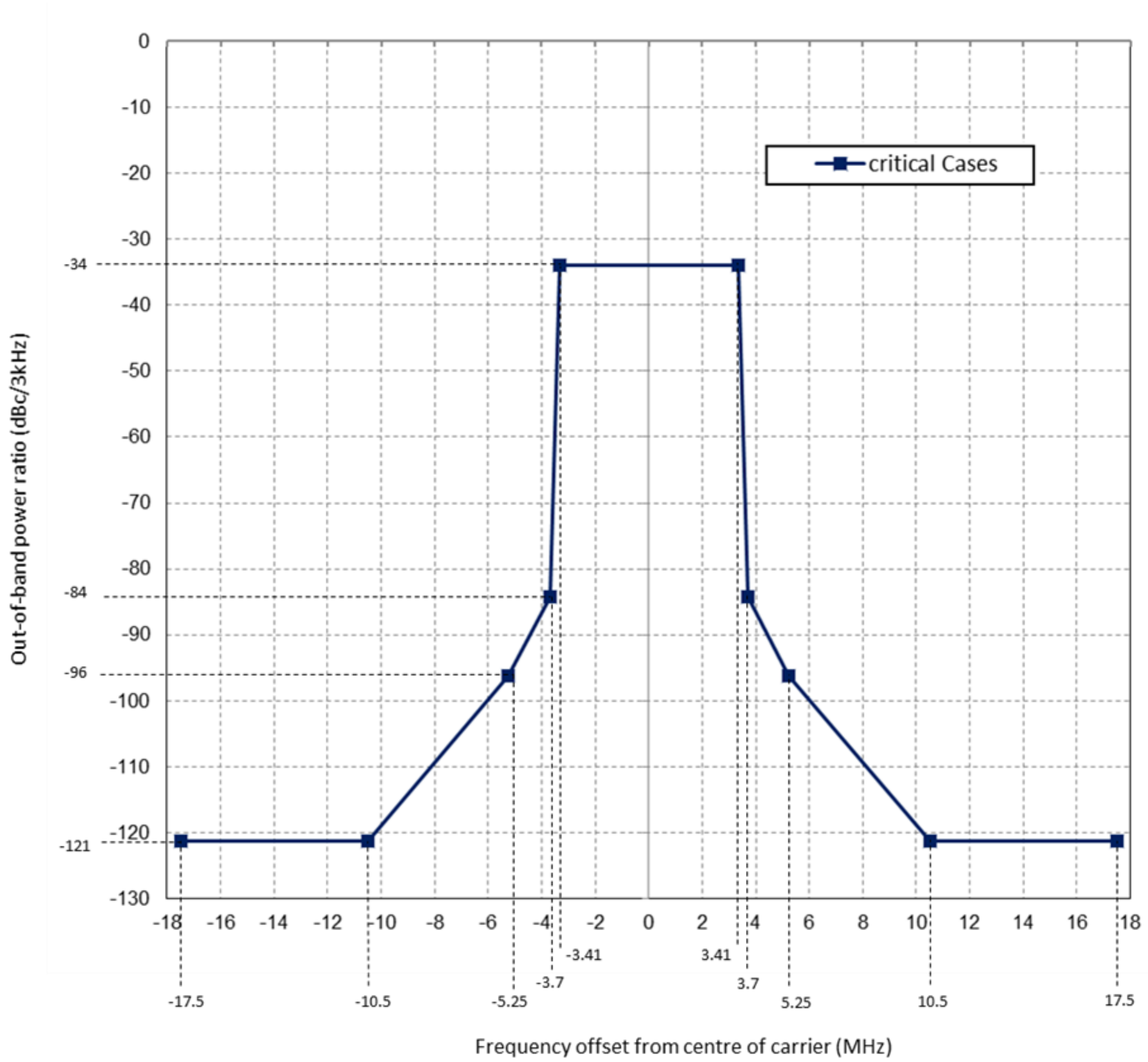


TABLE 5

Critical case ACLR limits (dB) for 7 DVB-T / T2 transmitters ≤25W, for 1st adjacent victim channels

		DVB-T/DVB-T2	DVB-T/DVB-T2
Power (watts)	**Power (dBm)**	**ACLR (dB) 1st adjacent channel**	**ACLR (dB) 2nd Adjacent channel**
≤25	≤44	55	77

3.1.2 ATSC Reference broadcasting networks

Reference broadcast transmitter configurations are provided that are representative of actual deployments[5].

3.1.2.1 DTTB System A (ATSC) single transmitter

– High power
  - e.r.p.: 160 kW
  - Antenna height above average terrain (HAAT): 305 m
  - Antenna pattern: Omnidirectional
– Medium power
  - e.r.p.: 30 kW
  - Antenna height above average terrain (HAAT): 610 m
  - Antenna pattern: Omnidirectional
– Low power
  - e.r.p.: 10 kW
  - Antenna height above average terrain (HAAT): 1 000 m
  - Antenna pattern: Omnidirectional

NOTE – The values provided are based on the premise that a higher antenna can cover a specific area with less power. The point being to avoid interference from transmitters operating in adjacent areas.

The specific numbers represent three typical scenarios frequently found in the United States of America and were derived from the FCC database. FCC rules (47CFR 73.614) describe the relationship between the maximum allowable ERP and HAAT.

3.1.2.2 Vertical radiation pattern

The field strength in the vicinity of the broadcast VHF transmitting station is a function of the vertical radiation pattern of the transmitting antenna. The values in Table 6 below are to be used for sharing studies[6].

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[5] Values are derived from the Consolidated Data Base System (CDBS) found at: http://transition.fcc.gov/ftp/Bureaus/MB/Databases/cdbs/index.html.

[6] See: http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet69/oet69.pdf.

TABLE 6

Vertical VHF radiation pattern

Angle from horizon (degrees)	Relative field strength
0.75	1.000
1.50	0.970
2.00	0.940
2.50	0.890
3.00	0.820
3.50	0.730
4.00	0.650
5.00	0.470
6.00	0.330
7.00	0.280
8.00	0.280
9.00	0.280
10.00	0.250

To allow for null fill the value of the relative field strength should not go below 0.250 at all angles.

Relative Field Strength given above are linear values, to convert them to reduction values in dB the following equations is used:

$$Reduction\ in\ dB = 20 * log10(Relative\ Field\ Strength)$$

3.1.3 ISDB-T Reference broadcasting networks

Reference broadcast transmitter configurations are provided that are representative of actual deployments.

3.1.3.1 DTTB System C (ISDB-T) single transmitter

– High power
  - e.r.p.: 16 kW
  - Antenna height above average terrain (HAAT): 150 m
  - Antenna pattern: Omnidirectional
– Medium power
  - e.r.p.: 1.6 kW
  - Antenna height above average terrain (HAAT): 150 m
  - Antenna pattern: Omnidirectional
– Low power
  - e.r.p.: 0.16 kW
  - Antenna height above average terrain (HAAT): 150 m
  - Antenna pattern: Omnidirectional

3.1.3.2 Vertical radiation pattern

The normalized field strength in the vicinity of the broadcast transmitting station is a function of the vertical radiation pattern of the transmitting antenna. The equation below is an approximation to be used for sharing studies.

$$E(\theta) = abs\left(\frac{\sin\psi}{\psi}\right)$$

where:

$$\Psi = \pi A \sin(\theta - \beta)$$

and

- A = the antenna vertical aperture in wavelengths
- β = the beam tilt radians below the horizontal.

$E(\theta)$ given above are linear values, to convert them to reduction values in dB the following equation is used:

$$Reduction\ in\ dB = 20 * \log10\{E(\theta)\}$$

3.1.4 DTMB Reference broadcasting networks

Reference broadcast transmitter configurations are provided that are representative of actual deployments.

3.1.4.1 DTTB System D (DTMB) single transmitter

– High power
  - ERP: 20kW
  - Effective antenna height: 300 m
  - Antenna height a.g.l.: 100 m
  - Antenna pattern: Omnidirectional

– Medium power
  - ERP: 2 kW
  - Effective antenna height: 150 m
  - Antenna height a.g.l.: 50 m
  - Antenna pattern: Omnidirectional

– Low power
  - ERP: 250 W
  - Effective antenna height: 50 m
  - Antenna height a.g.l.: 20 m
  - Antenna pattern: Omnidirectional

3.1.4.2 Vertical radiation pattern

The normalized field strength in the vicinity of the broadcast transmitting station is a function of the vertical radiation pattern of the transmitting antenna. The equation below is an approximation to be used for sharing studies.

$$E(\theta) = abs\left(\frac{\sin\psi}{\psi}\right)$$

where:

$$\Psi = \pi A \sin(\theta - \beta)$$

and

A = the antenna vertical aperture in wavelengths

β = the beam tilt radians below the horizontal.

$E(\theta)$ given above are linear values, to convert them to reduction values in dB the following equation is used:

$$Reduction\ in\ dB = 20 * log10\{E(\theta)\}$$

3.2 Television reception parameters for use in sharing and compatibility studies

3.2.1 Parameters Common to all systems

3.2.1.1 Fixed antenna reference height

The reference receiving antenna height considered to be representative in calculating the field strength for fixed reception is 10 m above ground level.

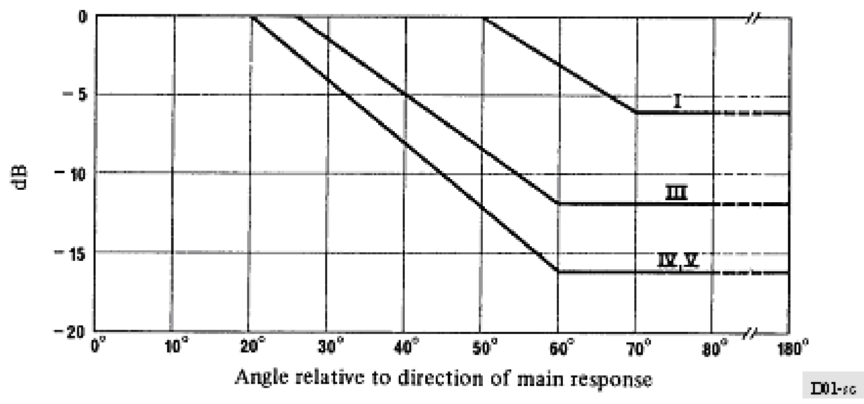
3.2.1.2 Fixed antenna radiation pattern

Standard radiation patterns for receiving antennas for Bands I, III, IV and V, Fig. 5, are given in Recommendation ITU-R BT.419-3.

FIGURE 5

Discrimination obtained by the use of directional receiving antennas in broadcasting

(The number of the broadcasting band is shown on the curve)



3.2.1.3 Portable antenna reference height

For portable (indoor and outdoor) reception, a receiving antenna height of 1.5 m above ground level is used.

3.2.1.4 Polarization discrimination for portable reception

Polarization discrimination should not be taken into account in frequency planning for portable reception[7].

3.2.1.5 Height loss correction

Since all field-strength calculations are for a receiving antenna height of 10 m, a height loss correction factor for an antenna height of 1.5 m should be used in the calculation of minimum median field-strength levels. For planning purposes, the height-loss values for portable reception for reference frequencies are given in Table 7.

TABLE 7

Suburban and Urban height loss in Bands III[8]

Frequency (MHz)	200
Suburban height loss (dB)	12
Urban height loss (dB)	19

3.2.1.6 Building entry loss

Table 8 contains the mean values for building entry loss and the corresponding standard deviation, for a traditional buildings provided by Recommendation ITU-R P.2109-0. These values should be used in sharing and interference studies involving all broadcast systems.

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[7] Recommendations ITU-R BT.1368-13 and ITU-R BT.2033-1.

[8] Refer to Recommendation ITU-R P.1546-5. They are equivalent to the values provided in GE06.

TABLE 8

Building entry loss

	Building entry loss	Standard deviation
≤200 MHz	10.5	8.2 dB

NOTE – Studies of building entry loss have meant figures have changed over time with Recommendation P.2109-0 representing the latest work. BT.1368-13 does not provide building loss values for Band III, GE06, BT.2033-1 and BS.1660-7 gave a figure of 9 dB with a standard deviation of 3 dB.

3.2.1.7 Antenna gain frequency correction

Within any frequency band, the variation of antenna gain with other frequency may be taken into account by the addition of a correction term:

$$\mathrm{Corr} = 10\log\left(\mathrm{F}_A / \mathrm{F}_\mathrm{R}\right)$$

where:

Corr is the correction term

F_A is the actual working frequency being considered

F_R is the reference frequency.

Minimum median field strength levels for other frequencies are derived by interpolation as described in § 3.2.1.8.

3.2.1.8 Interpolation of reference field strength values

For frequencies other than those quoted in tables, as described in Appendix 3.5 of Chapter 3 of the Final Acts of RRC06, the reference field-strength values should be adjusted by adding the correction factor defined according to the following rule:

– $(E_{med})_{ref}(f) = (E_{med})_{ref}(f_r)$ + Corr;

– for fixed reception, Corr = 20 $\log_{10}(f/f_r)$, where f is the actual frequency and f_r the reference frequency in the table;

– for portable reception and mobile reception, Corr = 30 $\log_{10}(f/f_r)$ where f is the actual frequency and f_r the reference frequency in the table.

3.2.1.9 Location Variability Correction[9]

Recommendation ITU-R P.1546-5, Annex 5 Table 2, gives a standard deviation of 5.5 dB for wideband broadcast signals. This value should be used to determine the field-strength variation at locations.

[9] Also referred to as variability due to shadowing – shadow loss fading.

3.2.2 DVB-T / DVB-T2 – System specific receive parameters

3.2.2.1 General parameters

TABLE 9

General DVB-T/T2 parameters

Parameter	Fixed reception	Portable reception (outdoor/Mobile or indoor)
	DVB-T/T2	DVB-T/T2
Signal band width (MHz)	6 6.66	
Thermal noise density (kT0) (dBm/Hz)	−173.98	
Receiver noise figure [(1), (2)] (dB)	5 / 6	
Allowance for manmade noise [(3)] (dB)	2	8

(1) ITU-R BT 1368-13, Table 53.

(2) ITU-R BT 2033-1, Table 12.

(3) ITU-R BT 2033-1, Table 31.

3.2.2.2 Carrier to noise

Within GE06, Recommendations ITU-R BT.1368-13 for DVB-T and in ITU-R BT.2033-1 for DVB-T2, carrier to noise figures are provided. For compatibility and sharing studies the values in Table 10 should be used for both systems.

TABLE 10

Carrier-to-noise ratio DVB-T & DVB-T2

Fixed reception	Portable reception
20 dB	18 dB

3.2.2.3 Fixed reception definition

Fixed reception is defined as reception where a directional receiving antenna mounted at roof level is used.

It is assumed that near-optimal reception conditions (within a relatively small volume on the roof) are found when the antenna is installed.

In calculating the field strength for fixed antenna reception, a receiving antenna height of 10 m above ground level is considered to be representative for the broadcasting service. Other heights might be used for other services.

3.2.2.3.1 Fixed antenna system gain

For fixed reception the antenna gain values (relative to a half-wave dipole) used in the derivation of the minimum median equivalent field-strength values are given in Table 11.

TABLE 11

Antenna gain (relative to a half-wave dipole) in Bands III

Frequency (MHz)	200
Antenna gain (dBd) (1)	7
Feeder loss (dB)	2
Antenna system gain (dBd) (2)	5

(1) Recommendation ITU-R BT.1368-13, Table 53 gives an antenna gain of 5 dBd with a feeder loss of 3 dB for a total antenna system gain of 2 dBd. GE06 and Recommendation ITU-R BT.2033-1 use an antenna gain of 7 dBd with a feeder loss of 2 dB for a total antenna system gain of 5 dBd.

(2) The antenna gain is equivalent to 9.15 dBi and the antenna system gain is equivalent to 7.15 dBi.

3.2.2.3.2 Polarization discrimination fixed reception

For calculation of interference:

– For Terminal station (UE) polarization discrimination must not be applied.

– For Base Station (BS) polarization discrimination may be applied. The combined value of polarization discrimination and discrimination offered by receive aerial directivity must not be more than 12 dB[10].

3.2.2.3.3 Location probability – fixed reception

For fixed reception, the location probability as given in Table 12 should be used.

TABLE 12

Location Probability for fixed Reception

System	DVB-T(GE06)/DVB-T2
Location Probability (%)	95

3.2.2.4 Portable reception definition

Portable reception is defined as:

– outdoor – which means reception by a portable receiver with an attached or built-in antenna is used outdoors at no less than 1.5 m above ground level;

– indoor – which means reception by a portable receiver with an attached or built-in antenna is used indoors at no less than 1.5 m above floor level in rooms with a window in an external wall.

In both cases, it is assumed that optimal receiving conditions will be found by moving the antenna up to 0.5 m in any direction and extreme cases, such as reception in completely shielded rooms, are disregarded.

10 Refer to Recommendation ITU-R BT 419-3.

3.2.2.4.1 Portable receive antenna gain

Recommendations ITU-R BT.1368-13 in its Annex 6, § 4.1 and ITU-R BT.2033-1 in Table 12 give information on antennas for portable reception. For portable reception, an omnidirectional antenna pattern should be applied with no feeder loss. For compatibility and sharing studies the antenna gain (relative to a half-wave dipole) given in Table 13 should be used for both systems.

TABLE 13

Antenna gain (dBd) for portable reception

Band	**Gain (dBd)**
Band III	–2.15

Note: This is equivalent to 0 dBi.

3.2.2.4.2 Polarization discrimination portable reception

Polarization discrimination should not be taken into account in frequency planning for portable reception[11].

3.2.2.4.3 Location probability – portable reception

For portable reception, the location probability as given in Table 14 should be used.

TABLE 14

Location Probability for Portable Reception

System	DVB-T/DVB-T2(GE06)
Portable location probability (%)	95

3.2.2.5 Minimum field strength at 200 MHz

TABLE 15

DVB-T Minimum field strength at 10 m a.g.l. suburban f_r = 200 MHz

Fixed reception at 10 m for 95% location probability	**Portable outdoor reception at 1.5 m for 95% location probability**	**Portable indoor reception at 1.5 m for 95% location probability**
46.4 dBµV/m	69.5 dBµV/m	87.2 dBµV/m

[11] Recommendation ITU-R BT.1368-13.

TABLE 16

DVB-T2 Minimum field strength at 10 m a.g.l. suburban f_r = 200 MHz

Fixed reception at 10 m for 95% location probability	Portable outdoor reception at 1.5 m for 95% location probability	Portable indoor reception at 1.5 m for 95% location probability
47.4 dBµV/m	70.5 dBµV/m	88.2 dBµV/m

Minimum median field-strength levels for other frequencies than 200 MHz are derived by the correction described in § 3.2.1.8.

3.2.2.6 Link budgets

Link budgets for DVB-T and DVB-T2 for fixed rooftop, portable outdoor and portable indoor reception are provided in Annex 5.

3.2.2.7 Signal time percentage

TABLE 17

Time percentages used for sharing and compatibility studies

System	Wanted field strength	Interfering field strength
DVB-T/DVB-T2	50%	1%

3.2.2.8 Protection ratios and overload threshold for interference from other services

Recommended values for protection ratios (PR) and overloading thresholds for DVB-T systems to be used in sharing studies can be found in Recommendation ITU-R BT.1368-13 Annex 2. Recommended values for protection ratios and overloading threshold for DVB-T2 receivers can be found in Annex 1 of Recommendation ITU-R BT.2033-1.

3.2.2.9 Correction of protection ratio figures for different ACLR values

Recommendation ITU-R BT.1368-13 Attachment 3 to Annex 2 describes calculation to derive protection ratios for all DTB systems for different ACLR values.

3.2.3 ATSC – System specific receive parameters

3.2.3.1 General parameters

TABLE 18

General ATSC VHF parameters

Parameter	
Channel bandwidth (MHz)	6
Thermal noise density (kT_0) (dBm/Hz)	–173.98
Receiver noise figure (dB)	10
Man-made noise (dB)	0

3.2.3.2 Carrier to noise

TABLE 19

Carrier-to-noise ratio

Fixed reception	Portable reception
15.0 dB	15.0 dB

3.2.3.3 Fixed antenna system gain

For fixed reception the antenna gain values (relative to a half-wave dipole) used in the derivation of the minimum median equivalent field-strength values are given in Table 20.

TABLE 20

Antenna gain (relative to a half-wave dipole) in Bands III

Frequency (MHz)	200
Antenna gain (dBd)	6
Feeder loss (dB)	2
Antenna system gain (dBd) (1)	4

(1) Antenna system gain is equivalent 6.15 dBi.

3.2.3.4 Polarization discrimination fixed reception

Polarization discrimination should not be taken into account in frequency planning for fixed reception due to the possibility of multipath interference.

3.2.3.5 Location probability – fixed reception

For fixed reception, the location probability as given in Table 21 should be used.

TABLE 21

Location probability for fixed reception

System	ATSC
Location Probability (%)	50

3.2.3.6 Portable reception definition

Portable reception is defined as:

– outdoor – which means reception by a portable receiver with an attached or built-in antenna is used outdoors at no less than 1.5 m above ground level;

– indoor – which means reception by a portable receiver with an attached or built-in antenna is used indoors at no less than 1.5 m above floor level in rooms with a window in an external wall.

3.2.3.7 Portable receive antenna gain

For portable reception Recommendation ITU-R BT.1368-13 gives in its Annex 6, § 4.1, information on antennas. For portable reception, an omnidirectional antenna should be applied. The antenna gain (relative to a half-wave dipole) is as given in Table 22.

TABLE 22

Antenna gain (dBd) for portable reception

Band	Gain (dBd)
Band III	−2.15 [(1)]

(1) This is equivalent to 0 dBi.

3.2.3.8 Portable reception definition

Polarization discrimination should not be taken into account in frequency planning for portable reception[12].

3.2.3.9 Location probability – portable reception

For portable indoor and outdoor reception, the location probability as given in Table 23 should be used.

TABLE 23

Location probability for portable reception

System	ATSC
Location probability (%)	50

3.2.3.10 Minimum field strength at 200 MHz

TABLE 24

Minimum field strength at f_r = 200 MHz

Fixed reception at 10 m for 50% location probability	Portable outdoor reception at 1.5 m for 50% location probability
36 dBμV/m	64.5 dBμV/m

3.2.3.11 Link budgets

Link budgets for ATSC for fixed rooftop and portable outdoor reception are provided in Annex 5.

[12] Recommendation ITU-R BT.1368-13.

3.2.3.12 Signal time percentage

TABLE 25

Time percentages used for sharing and compatibility studies

System	Wanted field strength	Interfering field strength
ATSC	90%[13]	1%

3.2.3.13 Protection ratios and overload threshold for interference from other services

Recommended values for protection ratios (PR) and overloading thresholds for ATSC systems to be used in sharing studies can be found in Annex 1 to Recommendation ITU-R BT.1368-13.

3.2.3.14 Correction of protection ratio figures for different ACLR values

Recommendation ITU-R BT.1368-13 Attachment 3 to Annex 2 describes calculation to derive protection ratios for all DTTB systems for different ACLR values.

3.2.4 ISDB-T – System specific receive parameters

3.2.4.1 General parameters

TABLE 26

ISDB-T VHF parameters

Parameter	
Signal band width (6 MHz system) (MHz)	5.6
Thermal noise density (kT_0) (dBm/Hz)	−173.98
Receiver noise figure (dB)	5
Allowance for manmade noise (dB)	1

3.2.4.2 Carrier to noise

TABLE 27

Carrier-to-noise ratio

Fixed reception
20.1 dB

3.2.4.3 Fixed antenna system gain

For fixed reception the antenna gain values (relative to a half-wave dipole) used in the derivation of the minimum median equivalent field-strength values are given in Table 28.

---

[13] Field strength (90%) = field strength (50%) − {field strength(10%) − field strength (50%)}.

TABLE 28

Antenna gain (relative to a half-wave dipole) in Bands III

Frequency (MHz)	200
Antenna gain in relation to half-wave dipole (dBd)	5
Feeder loss (dB)	3
Antenna system gain (dBd) (1)	2

(1) Antenna system gain is equivalent to 4.15 dBi.

3.2.4.4 Polarization discrimination fixed reception

Polarization discrimination should not be taken into account in frequency planning for fixed reception due to the possibility of multipath interference.

3.2.4.5 Location probability – fixed reception

For fixed reception, the location probability as given in Table 29 should be used.

TABLE 29

Location Probability for fixed Reception

System	ISDB-T
Location probability (%)	95

3.2.4.6 Minimum field strength at 200 MHz

TABLE 30

Minimum field strength at f_r = 200 MHz

Fixed reception at 10 m for 95% location probability
47.6 dBμV/m

Minimum median field-strength levels for other frequencies than 200 MHz are derived by the correction described in § 11.4, Report ITU-R BT.2383-1.

3.2.4.7 Link budget – fixed outdoor reception

Link budgets for ISDB-T for fixed rooftop reception is provided in Annex 5.

3.2.4.8 Signal time percentage

TABLE 31

Time percentages used for sharing and compatibility studies

System	Wanted field strength	Interfering field strength
ISDB-T	90%[14]	10%

3.2.4.9 Protection ratios and overload threshold for interference from other services

Recommended values for protection ratios (PR) and overloading thresholds for ISDB-T systems to be used in sharing studies can be found in Annex 3 of Recommendation ITU-R BT.1368-13.

3.2.4.10 Correction of protection ratio figures for different ACLR values

Recommendation ITU-R BT.1368-13 Attachment 3 to Annex 2 describes the calculation method to derive protection ratios for all DTTB systems for different ACLR values.

3.2.5 DTMB – System specific receive parameters

3.2.5.1 General parameters

TABLE 32

General DTMB – VHF parameters

Parameter	Fixed reception Portable reception (outdoor/Mobile or indoor)
Signal band width (MHz)	7.56
Thermal noise density (kT_0) (dBm/Hz)	–173.98
Receiver noise figure[15] (dB)	5
Allowance for manmade noise (dB)	1

3.2.5.2 Carrier to noise

TABLE 33

Carrier-to-noise ratio

Fixed reception	Portable reception
19 dB	14 dB

[14] Field strength (90%) = field strength (50%) – {field strength(10%) – field strength (50%)}.

[15] Refer to Recommendation ITU-R BT.1368-13, Annex 2.

3.2.5.3 Fixed antenna system gain

For fixed reception the antenna gains used in the derivation of the minimum median field strength are given in Table 34.

Antenna gain used in the derivation of the minimum median field strength.

TABLE 34

Antenna gain used in the derivation of the minimum median field strength

Band	III
Reference frequency (MHz)	200
Antenna gain (dBd)	5
Feeder loss (dB)	3
Antenna system gain (dBd) (1)	2

(1) Antenna system gain is equivalent to 4.15 dBi.

3.2.5.4 Polarization discrimination fixed reception

For calculation of interference:

– For Terminal station (UE) polarization discrimination must not be applied.

– For Base Station (BS) polarization discrimination may be applied. The combined value of polarization discrimination and discrimination offered by receive aerial directivity must not be more than 12 dB[16].

3.2.5.5 Location probability – fixed reception

For fixed reception, the location probability as given in Table 35 should be used.

TABLE 35

Location Probability for fixed Reception

System	DTMB
Location probability (%)	95

3.2.5.6 Portable reception definition

Portable reception is defined as:

– outdoor – which means reception by a portable receiver with an attached or built-in antenna is used outdoors at no less than 1.5 m above ground level;

– indoor – which means reception by a portable receiver with an attached or built-in antenna is used indoors at no less than 1.5 m above floor level in rooms with a window in an external wall.

In both cases, it is assumed that optimal receiving conditions will be found by moving the antenna up to 0.5 m in any direction and extreme cases, such as reception in completely shielded rooms, are disregarded.

[16] Refer to Recommendation ITU-R BT.419-3.

3.2.5.7 Portable receive antenna gain

Recommendation ITU-R BT.1368-13 gives in its Annex 6, § 4.1, information on antennas for portable reception. For portable reception, an omnidirectional antenna should be applied with no feeder loss. The antenna gain (relative to a half-wave dipole) is as given in Table 36.

TABLE 36

Antenna gain (dBd) for portable reception

Band	Gain (dBd)
Band III	−2.15

Note 1: Antenna gain is equivalent to 0 dBi.

3.2.5.8 Polarization discrimination portable reception

Polarization discrimination should not be taken into account in frequency planning for fixed reception.

3.2.5.9 Location probability – portable reception

For portable indoor and outdoor reception, the location probability as given in Table 37 should be used.

TABLE 37

Location Probability for portable Reception

System	DTMB
Location probability (%)	95

3.2.5.10 Minimum field strength at 200 MHz

TABLE 38

Minimum field strength at f_r=200 MHz

Fixed reception at 10 m for 95% location probability	Portable outdoor reception at 1.5 m for 95% location probability
48.9 dBμV/m	83.7 dBμV/m

3.2.5.11 Link budget – fixed outdoor reception

Link budgets for DTMB for fixed rooftop and portable indoor reception are provided in Annex 5.

3.2.5.12 Signal time percentage

TABLE 39

Time percentages used for sharing and compatibility studies

System	Wanted field strength	Interfering field strength
DTMB	50%	1%

4 Sound systems

4.1 Sound transmission parameters for use in sharing and compatibility studies

4.1.1 DAB reference broadcasting networks

Reference broadcast transmitter configurations are provided that are representative of actual deployments in the case of assignments or are the reference configurations used in the GE06 Agreement for allotment planning.

4.1.1.1 DAB Single transmitter case (assignments):

– High power
  - e.r.p.: 10 kW
  - Effective antenna height: 300 m
  - Antenna height a.g.l.: 100 m
  - Antenna pattern:
    - Horizontal: Omnidirectional
    - Vertical antenna aperture: based on 12λ aperture with 2° beam tilt

– Medium power
  - e.r.p.: 1 kW
  - Effective antenna height: 150 m
  - Antenna height a.g.l.: 50 m
  - Antenna pattern:
    - Horizontal: Omnidirectional
    - Vertical: based on 6λ aperture with 3.2° beam tilt

– Low power
  - e.r.p.: 50 W
  - Effective antenna height: 50 m
  - Antenna height a.g.l.: 20 m
  - Antenna pattern:
    - Horizontal: Directional
    - Vertical: based on 2λ aperture with 6° beam tilt

The attenuation (A_ϑ) of the horizontal radiation pattern with azimuth angle (ϑ) is given by:

$$A_\vartheta = 20\log_{10}(2B - B^2)\ \text{dB}$$

where:

$$B = \frac{1 + k + \cos(\vartheta)}{2 + k}$$

where:

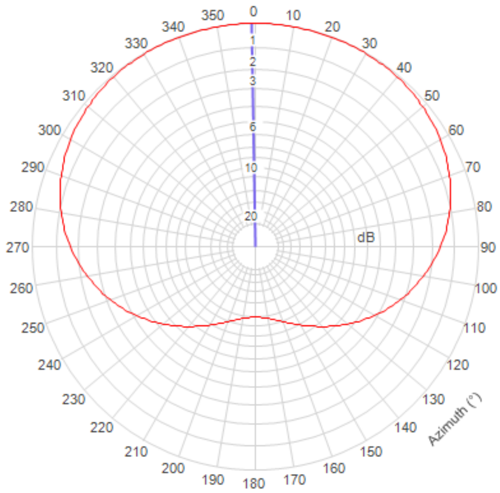
ϑ : azimuth angle

k : 0.4187 for 10 dB pattern minima.

The resulting pattern is shown in Fig. 6:

FIGURE 6

Low power DAB



Unlike high and medium power antennas which are usually omnidirectional, few low power DAB antenna are omnidirectional. Low power DAB antennas typically have a directional horizontal radiation pattern usually of a type cardioid (dipoles mounted on a pole) or consisting of one or more panel, Yagi or log-periodic elements. These antennas typically have minima in the HRP that are 10 dB or more below the maximum and may have lobes that occur at various azimuth angles, lobes typically being aligned with the desired service area.

As patterns of low power antenna vary considerably modelling all combinations of pattern in generic compatibility studies is usually not practical. Therefore to better represent the horizontal radiation pattern of low power DAB it is proposed to base the generic model on the pattern of a cardioid antenna with a 10 dB minimum. Depending on the compatibility study being undertaken the orientation of the pattern (angle of azimuth) can be varied as required.

4.1.1.2 Vertical radiation patterns

The normalized field strength in the vicinity of the broadcast transmitting station is a function of the vertical radiation pattern of the transmitting antenna. The equation below is an approximation to be used for sharing studies.

$$E(\theta) = abs\left(\frac{\sin\psi}{\psi}\right)$$

where:

$$\Psi = \pi A \sin(\theta - \beta)$$

and

A = the antenna vertical aperture in wavelengths

β = the beam tilt radians below the horizontal.

Null fill is not normally applied to DAB antennas.

E(θ) given above are linear values, to convert them to reduction values in dB the following equation is used:

$$Reduction\ in\ dB = 20 * \log10\{E(\theta)\}$$

4.1.1.3 Out of Band Mask

Out-of-band (OOB) emission limits of DAB transmitters to use in compatibility studies are based on ETSI EN 302 277[17].

Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excludes spurious emissions.

For the purposes of the present document out-of-band emissions are emissions at frequencies outside the necessary bandwidth and within the frequency ranges fL – 3 MHz to fL, where fL is the centre frequency of the lowest frequency OFDM block, and fH to fH + 3 MHz, where fH is the centre frequency of the highest frequency OFDM block of the transmission, irrespective of the number of blocks employed. In the case of a single block transmitter, fL = fH.

Out-of-band emissions should not exceed the limits specified in Table 40, additionally shown in Figs 7 and 8.

Out-of-band emissions limits are given as mean power level measured in a 4 kHz bandwidth, where 0 dB corresponds to the mean output power.

Initial compatibility studies should be based on the non-critical case (case 2).

Case 1: The solid line mask (see Fig. 7) should apply to DAB transmitters operating in areas critical for adjacent channel DAB to DAB interference, and in any case when it is necessary to protect other services operating on adjacent frequencies on a primary basis (same as GE06 sensitive cases).

Case 2: The dashed line mask (see Fig. 7) should apply to DAB transmitters in other cases. (same as GE06 non-critical cases).

Case 3: The solid line mask (see Fig. 8) should apply to DAB transmitters in exceptional circumstances to protect safety services.

Case 4: The chain dotted line mask (see Fig. 8) should apply to DAB transmitters operating on a case by case basis in certain areas. (same as GE06 to be applied where frequency block 12D is used).

TABLE 40

Out-of-band spectrum table for a DAB transmission signal

	Frequency relative to the centre of the 1.54 MHz channel (MHz)	**Relative level (dB)**
Case 1 – Spectrum mask for DAB transmitters operating in critical cases	±0.77	–26
	±0.97	–71
	±1.75	–106
	±3.0	–106

[17] ETSI EN 302 277v2.1.0 (2016-03), "Transmitting equipment for the Digital Audio Broadcast (DAB) service; Harmonised Standard for access to radio spectrum".

	Frequency relative to the centre of the 1.54 MHz channel (MHz)	Relative level (dB)
Case 2 – Spectrum mask for DAB transmitters operating in uncritical cases	±0.97	–26
	±0.97	–56
	±3.0	–106
Case 3 – Transmitters operating in exceptional circumstances to protect safety services	±0.77	–26
	±0.97	–71
	±1.75	–126
	±3.0	–126
Case 4 – Spectrum mask for DAB transmitters operating on a case by case basis in certain areas	±0.77	–26
	±0.97	–78
	±2.2	–126
	±3.0	–126

FIGURE 7

Spectrum masks for DAB out-of-band emissions (case 1 and case 2)

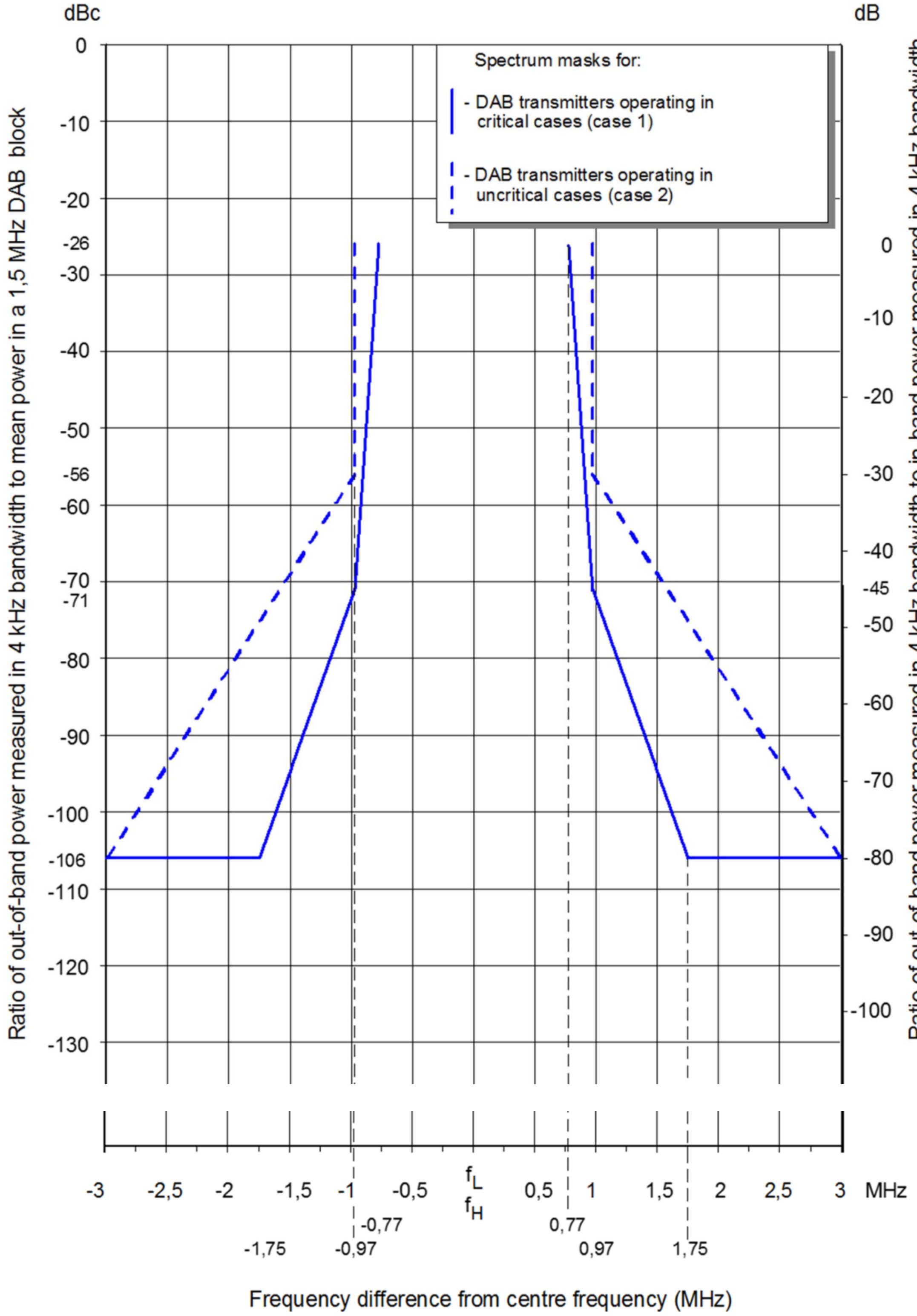
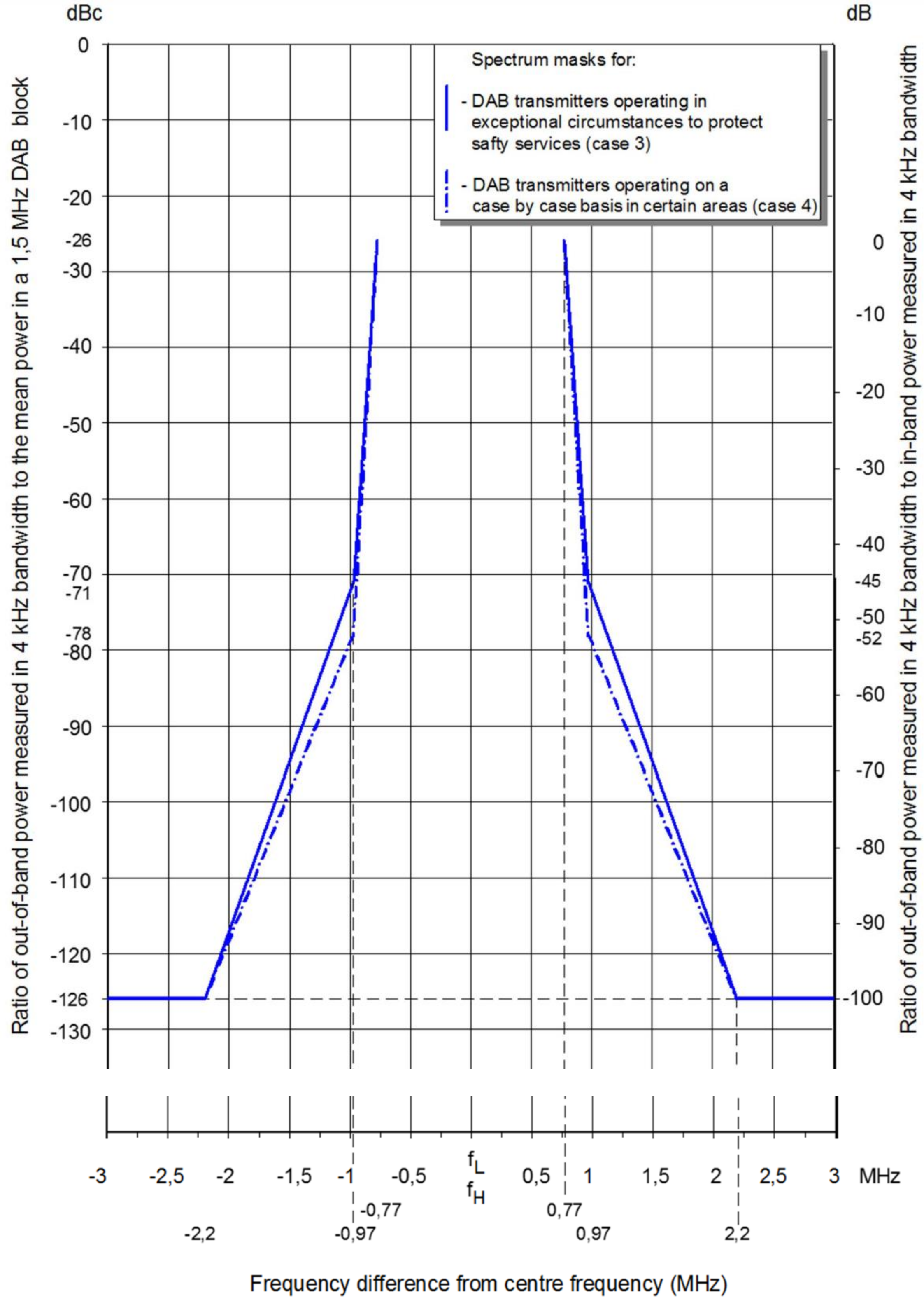


FIGURE 8

Spectrum masks for DAB out-of-band emissions (case 3 and case 4)



4.2 Sound reception parameters for use in sharing and compatibility studies

4.2.1 Parameters Common to all systems

4.2.1.1 Fixed antenna reference height

The reference receiving antenna height considered to be representative in calculating the field strength for fixed reception is 10 m above ground level. In order to derive the minimum median field-strength levels, the receiving antenna gain and feeder-loss values are given in Section 3.

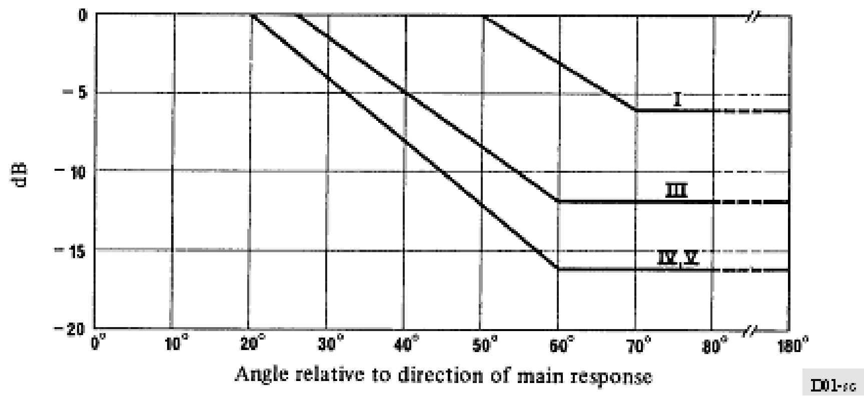
4.2.1.2 Fixed antenna radiation pattern

Standard radiation patterns for receiving antennas for Bands I, III, IV and V, Fig. 9, are given in Recommendation ITU-R BT.419-3.

FIGURE 9

Discrimination obtained by the use of directional receiving antennas in broadcasting

(The number of the broadcasting band is shown on the curve)



4.2.1.3 Portable antenna reference height

For portable (indoor and outdoor) reception, a receiving antenna height of 1.5 m above ground level is used.

4.2.1.4 Polarization discrimination for portable reception

Polarization discrimination should not be taken into account in frequency planning for portable reception[18].

4.2.1.5 Height loss correction

Since all field-strength calculations are for a receiving antenna height of 10 m, a height loss correction factor for an antenna height of 1.5 m should be used in the calculation of minimum median field-strength levels. For planning purposes, the height-loss values for portable reception for reference frequencies are given in Table 41.

---

[18] Recommendation ITU-R BS.1660.

TABLE 41

Suburban and Urban height loss in Bands III[19]

Frequency (MHz)	200
Suburban height loss (dB)	12
Urban height loss (dB)	19

4.2.1.6 Building entry loss

Table 42 contains the mean values for building entry loss and the corresponding standard deviation taken from Recommendation ITU-R P.2109-0.

TABLE 42

Building entry loss at 200 MHz

Building entry loss	**Standard deviation**
10.5	8.2 dB

4.2.1.7 Antenna gain Frequency Correction

Within any frequency band, the variation of antenna gain with other frequency may be taken into account by the addition of a correction term:

$$\text{Corr} = 10\log\left(F_A / F_R\right)$$

where:

Corr is the correction term

F_A is the actual working frequency being considered

F_R is the reference frequency.

Minimum median field strength levels for other frequencies are derived by interpolation as described in § 4.2.1.8.

4.2.1.8 Interpolation of reference field strength values[(GE06)]

For frequencies other than those quoted in tables, as described in Appendix 3.5 of Chapter 3 of the Final Acts of RRC06, the reference field-strength values should be adjusted by adding the correction factor defined according to the following rule:

– $(E_{med})_{ref}(f) = (E_{med})_{ref}(f_r)$ + Corr;

– for fixed reception, Corr = 20 $\log_{10}(f/f_r)$, where f is the actual frequency and f_r the reference frequency in the Table;

– for portable reception and mobile reception, Corr = 30 log10 (f/fr) where f is the actual frequency and f_r the reference frequency in the Table.

[19] Refer to Recommendation ITU-R P.1546. The same as the value provided in GE06.

4.2.2 DAB – System specific receive parameters

4.2.2.1 General parameters

TABLE 43

General DAB parameters

Parameter	outdoor	indoor	mobile
Signal band width (MHz)	1.54		
Thermal noise density (kT_0) (dBm/Hz)	–173.98		
Receiver noise figure [(1)] (dB)	6		
Allowance for manmade noise (2) (dB)	1.5	5.3	0.9

(1) Report ITU-R BS.2214-3, § 7.2.1.

(2) Report ITU-R BS.2214-3, § 3.5 and Table 115.

The studies should consider three reception modes, mobile, portable outdoor and portable indoor reception.

4.2.2.2 Carrier to noise

DAB system *C*/*N* values to use in sharing studies are given in Table 44.

TABLE 44

Carrier-to-noise ratio[(1)]

Portable reception	Mobile Reception
11.9 dB	12.6

(1) Report ITU-R BS.2214-3, Table 115.

4.2.2.3 Portable reception definition

Portable reception is defined as:

– outdoor – which means reception by a portable receiver with an attached or built-in antenna is used outdoors at no less than 1.5 m above ground level;

– indoor – which means reception by a portable receiver with an attached or built-in antenna is used indoors at no less than 1.5 m above floor level in rooms with a window in an external wall.

In both cases, it is assumed that optimal receiving conditions will be found by moving the antenna up to 0.5 m in any direction and extreme cases, such as reception in completely shielded rooms, are disregarded.

4.2.2.4 Receive antenna gain

For portable and mobile reception, an omnidirectional antenna should be applied. The antenna gain (relative to a half-wave dipole) to use is as given in Table 45.

TABLE 45

DAB Band III Antenna gain (dBd) for portable and mobile reception[(1)]

Portable (dBd)	Mobile (dBd)
–8	–5

(1) Report ITU-R BS.2214-3, Table 115.

Note: The anntena gains are equivalent to -5.85 dBi and -2.85 dBi, respectively.

4.2.2.5 Polarization discrimination portable reception

Polarization discrimination should not be taken into account in frequency planning for portable reception.

4.2.2.6 Location probability – portable reception

TABLE 46

Location Probability for Portable Reception

System	DAB (GE06)
Portable Location Probability (%)	95
Mobile location Probability (%)	99

4.2.2.7 Minimum field strength at 200 MHz

TABLE 47

DAB Minimum field strength at f_r=200 MHz

Mobile reception for 99% location probability @ 10 m a.g.l.	Portable outdoor reception for 95% location probability @ 10 m a.g.l.	Portable indoor reception for 95% location probability @ 10 m a.g.l.
56.8 dBµV/m	57 dBµV/m	79.7 dBµV/m

Minimum median field-strength levels for other frequencies than 200 MHz are derived by the correction described in § 4.2.1.8.

4.2.2.8 Link budget – portable outdoor/indoor reception

Link budgets for DAB for mobile, portable outdoor and portable indoor reception are provided in Annex 6.

4.2.2.9 Protection ratios and overload threshold for interference from other services

Recommended values for protection ratios (PR) and overloading thresholds for DTMB systems to be used in sharing studies can be found in Annex 4 to Recommendation ITU-R BS.1660-8.

4.2.2.10 Correction of protection ratio figures for different ACLR values

Recommendation ITU-R BT.1368-13 Attachment 3 to Annex 2 describes the calculation method to derive protection ratios for all DTB systems for different ACLR values.

Annex 1

List of relevant ITU-R Reports and Recommendations

Additional information on the characteristics which are referred to in this Report can be found in ITU documents:

– Recommendation ITU-R BT.419 – Directivity and polarization discrimination of antennas in the reception of television broadcasting.

– Recommendation ITU-R BT.500 – Methodology for the subjective assessment of the quality of television pictures.

– Recommendation ITU-R BT.1368 – Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands.

– Recommendation ITU-R BT.2033 – Planning criteria, including protection ratios, for second generation of digital terrestrial television broadcasting systems in the VHF/UHF bands.

– Report ITU-R BT.2036 – Characteristics of a reference receiving system for frequency planning of digital terrestrial television systems.

– Report ITU-R BS.2214 – Planning parameters for terrestrial digital sound broadcasting systems in VHF bands.

– Final Acts of RRC06 – The GE06 Agreement[20].

– ITU-R DTTB Handbook.

– ITU-R DSB Handbook.

Additional information on the characteristics which are not referred to in this Report can be found in ITU documents:

– Recommendation ITU-R BS.774 – Service requirements for digital sound broadcasting to vehicular, portable and fixed receivers using terrestrial transmitters in the VHF/UHF bands.

– Recommendation ITU-R BS.1114 – Systems for terrestrial digital sound broadcasting to vehicular, portable and fixed receivers in the frequency range 30-3 000 MHz.

– Recommendation ITU-R BS.1195 – Transmitting antenna characteristics at VHF and UHF.

– Recommendation ITU-R BT.1206 – Spectrum limit masks for digital terrestrial television broadcasting.

– Recommendation ITU-R BT.1877 – Error-correction, data framing, modulation and emission methods for second generation of digital terrestrial television broadcasting systems.

– Recommendation ITU-R BT.1306 – Error correction, data framing, modulation and emission methods for digital terrestrial television broadcasting.

Additional information on the protection requirements which are referred to in this Report can be found in ITU documents:

[20] For Region 1 and the Islamic republic of Iran except the territory of Mongolia the use of the band 470-694 MHz is subject to the GE06 agreement.

– Recommendation ITU-R BT.1368 – Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands.

– Recommendation ITU-R BS.1660 – Technical basis for planning of terrestrial digital sound broadcasting in the VHF band.

– Recommendation ITU-R BT.1735 – Methods for objective reception quality assessment of digital terrestrial television broadcasting signals of System B specified in Recommendation ITU-R BT.1306.

– Recommendation ITU-R BT/BS.1895 – Protection criteria for terrestrial broadcasting systems.

– Final Acts of RRC06 – The GE06 Agreement.

– Recommendation ITU-R BT.2033 – Planning criteria, including protection ratios, for second generation of digital terrestrial television broadcasting systems in the VHF/UHF bands.

– Report ITU-R BT.2215 – Measurements of Protection Ratios and Overload Thresholds for Broadcast TV Receivers.

– Report ITU-R BT.2265 – Guidelines for the assessment of interference into the broadcasting service.

– Recommendation ITU-R BT.2036 – Characteristics of a reference receiving system for frequency planning of digital terrestrial television systems.

Additional information on the protection requirements which are not referred to in this Report can be found in ITU documents:

– Report ITU-R BT.2254 – Frequency and network planning aspects of DVB-T2.

Information on sharing and compatibility studies involving DTB can be found in ITU documents:

– Report ITU-R BT.2247 – Field measurement and analysis of compatibility between DTTB and IMT.

– Report ITU-R BT.2248 – A conceptual method for the representation of loss of broadcast coverage.

– Report ITU-R BT.2337 – Sharing and compatibility studies between digital terrestrial television broadcasting and terrestrial mobile broadband applications, including IMT, in the frequency band 470-694/698 MHz.

– Report ITU-R BT.2339 – Co-channel sharing and compatibility studies between digital terrestrial television broadcasting and international mobile telecommunication in the frequency band 694-790 MHz in the GE06 planning area.

– Report ITU-R BT.2383 – Characteristics of digital terrestrial television broadcasting systems in the frequency band 470-862 MHz for frequency sharing/interference analyses

Information on propagation matters referred to in this Report can be found in ITU documents:

– Recommendation ITU-R P.1546 – Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz.

Annex 2

General Definitions

A2.1 Broadcasting coverage area and service area planning

Recommendation ITU-R V.573-5 No. A51b defines "*coverage area*" as the "*area associated with a transmitting station for a given service and a specified frequency within which, under specified* *technical conditions, radiocommunications may be established with one or several receiving stations*".

Note 4 of No. A51b explains that "*the term 'service area 'should have the same technical basis as for 'coverage area', but also include administrative aspects*".

Reference to the administrative aspects in the definition of service area is understood to mean that in that service area protection is required.

For the case of broadcast services which are usually planned with multiple overlapping transmissions from different transmitter sites, it is usual to protect only the best coverage. Furthermore, spill-over coverage into international neighbors or adjacent regions of a country do not usually form part of the intended service area and may not require protection.

A2.2 Definition of reception location probability

Reception location probability is defined in Report ITU-R BT.2265-2 Section 2 as "*the percentage of locations within a small area, referred in this document as 'pixel'*[21]*, where the wanted signal is high enough to overcome noise and interference for a given percentage of time taking into account the temporal and spatial statistical variations of the relevant fields*".

In digital terrestrial broadcasting the coverage area is defined in Report ITU-R BT.2265-2. Annex 2 as "*the area that comprises all pixels, where a given reference reception location probability (e.g. 95%) is reached or exceeded for a predetermined percentage of the time*".

Annex 3

Allotment reference networks

A3.1 DTT Single frequency networks (Allotments)(GE06)

Three reference networks (RN) for DTT services in Region 1 will be used as described in Appendix 3.6 of Chapter 3 of the GE06 Agreement. This information is reproduced in part below.

For sharing studies within the service area of an SFN the same vertical diagrams as provided in § 7.1 above should be applied for each transmitter.

A3.1.1 Reference network 1 (large service-area SFN)

The network consists of seven transmitters situated at the centre and at the vertices of a hexagonal lattice. An open network type has been chosen, i.e. the transmitters have non-directional antenna patterns and the service area is assumed to exceed the transmitter hexagon by about 15%. The geometry of the network is given in Fig. A3-1. This reference network (RN 1) is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for Band III. RN 1 is intended for large service area SFN coverage. It is assumed that main transmitter sites with an appropriate effective antenna height are used as a backbone for this type of network. For portable and mobile reception, the size of the real service areas for this type of SFN coverage is restricted to

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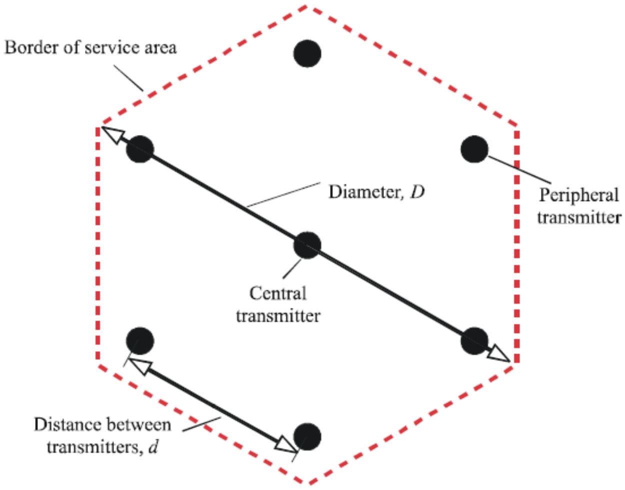
[21] Pixel is a small area of typically about 100 m × 100 m where the percentage of covered receiving locations is indicated.

150 to 200 km in diameter because of self-interference degradation, unless very rugged DVB-T system variants are used or the concept of dense networks is employed.

FIGURE A3-1

RN 1 (large service area SFN)



For the guard interval length, the maximum value 1/4 T_u of the 8k FFT mode is assumed. The distance between transmitters in an SFN should not significantly exceed the distance equivalent to the guard interval duration. In this case, the guard interval duration is 265 µs, which corresponds to a distance of 85 km. The distance between transmitters for RPC 1 is taken as 70 km. For RPC 2 and RPC 3, 70 km is too large a distance from a power budget point of view.

Therefore, smaller values for the distance between transmitters have been selected, 50 km for RPC 2 and 40 km for RPC 3.

The parameters and the power budgets of RN 1 given in Table A3-1 should be used.

TABLE A3-1

Parameters of RN 1 (large service area SFN)

RPC and reception type		RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor
Type of network		Open	Open	Open
Geometry of service area		Hexagon	Hexagon	Hexagon
Number of transmitters		7	7	7
Geometry of transmitter lattice		Hexagon	Hexagon	Hexagon
Distance between transmitters d (km)		70	50	40
Service area diameter D (km)		161	115	92
Tx effective antenna height (m)		150	150	150
Tx antenna pattern		Non-directional	Non-directional	Non-directional
e.r.p.(1) dB(W)	Band III	34.1	36.2	40.0

RPC and reception type	RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor

(1) The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.

The e.r.p. is given for 200 MHz in Band III; for other frequencies (*f* in MHz) the frequency correction factor added is: $20 \log_{10}(f/200)$ for RPC 1 and $30 \log_{10}(f/200)$ for RPC 2 and RPC 3.

A3.1.2 Reference network 2 (small service area SFN, dense SFN)

The network consists of three transmitters situated at the vertices of an equilateral triangle. An open network type has been chosen, i.e. the transmitters have non-directional antenna patterns. The service area is assumed to be hexagonal, as indicated in Fig. A3-2.

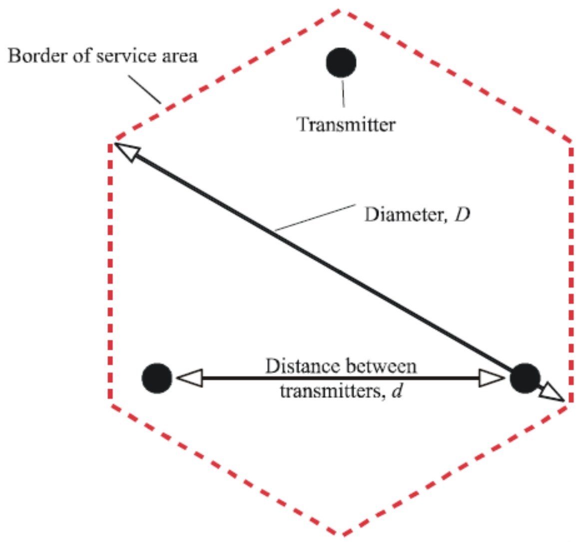
This reference network (RN 2) is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for Band III.

RN 2 is intended for small service area SFN coverage. Transmitter sites with appropriate effective antenna heights are assumed to be available for this type of network and self-interference restrictions are expected to be small. Typical service area diameters may be from 30 to 50 km.

It is also possible to cover large service areas with this kind of dense SFN. However, a very large number of transmitters is then necessary. It therefore seems reasonable to have large service areas being represented by RN 1, even if a dense network structure is envisaged.

FIGURE A3-2

RN 2 (small service area SFN)



In RN 2 the inter-transmitter distance is 40 km for RPC 1 and 25 km in the case of RPCs 2 and 3.

The parameters and the power budgets of the RN 2 given in Table A3-2 should be used.

TABLE A3-2

Parameters of RN 2 (small service area SFN)

RPC and reception type		**RPC 1 Fixed antenna**	**RPC 2 Portable outdoor and mobile**	**RPC 3 Portable indoor**
Type of network		Open	Open	Open
Geometry of service area		Hexagon	Hexagon	Hexagon
Number of transmitters		3	3	3
Geometry of transmitter lattice		Triangle	Triangle	Triangle
Distance between transmitters d (km)		40	25	25
Service area diameter D (km)		53	33	33
Tx effective antenna height (m)		150	150	150
Tx antenna pattern		Non-directional	Non-directional	Non-directional
e.r.p.(1) (dBW)	Band III	24.1	26.6	34.1

(1) The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.

The e.r.p. is given for 200 MHz in Band III; for other frequencies (f in MHz) the frequency correction factor added is: $20 \log_{10}(f/200)$ for RPC 1 and $30 \log_{10}(f/200)$ for RPC 2 and RPC 3.

A3.1.3 Reference network 3 (small service area SFN for urban environment)

The geometry of the transmitter lattice of reference network 3 (RN 3) and the service area are identical to those of RN 2 (see Fig. A3-2 above).

RN 3 is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for Band III.

RN 3 is intended for small service area SFN coverage in an urban environment. It is identical to RN 2, apart from the fact that urban-type height loss figures are used. This increases the required power of the SFN transmitters by about 5 dB for RPC 2 and RPC 3.

The parameters and the power budgets of the RN 3 given in Table A3-3 should be used.

TABLE A3-3

Parameters of RN 3 (small service area SFN for urban environment)

RPC and reception type		**RPC 1 Fixed antenna**	**RPC 2 Portable outdoor and mobile**	**RPC 3 Portable indoor**
Type of network		Open	Open	Open
Geometry of service area		Hexagon	Hexagon	Hexagon
Number of transmitters		3	3	3
Geometry of transmitter lattice		Triangle	Triangle	Triangle
Distance between transmitters d (km)		40	25	25
Service area diameter D (km)		53	33	33
Tx effective antenna height (m)		150	150	150
Tx antenna pattern		Non-directional	Non-directional	Non-directional
e.r.p.(1) (dBW)	Band III	24.1	32.5	40.1

(1) The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.

The e.r.p. is given for 200 MHz in Band III; for other frequencies (*f* in MHz) the frequency correction factor added is: $20 \log_{10}(f/200)$ for RPC 1 and $30 \log_{10}(f/200)$ for RPC 2 and RPC 3.

A3.2 DSB Single frequency networks (Allotments)(GE06)

Two reference networks (RN) for DAB services in Region 1 will be used as described in Appendix 3.6 of Chapter 3 of the GE06 Agreement. This information is reproduced in part below.

For sharing studies within the service area of an SFN the same vertical diagrams as provided in § 7.1.1 based on the aperture and beam tilt in § 7.3 above should be applied for each transmitter.

A3.2.1 Reference networks for DAB(GE06)

For DAB, two RPCs have been defined, RPC 4 for the mobile reception case and RPC 5 for the portable indoor reception case. Two corresponding reference networks have been designed which are identical apart from their power budget. They are directly connected to the two RPCs.

For RPC 4, the mobile reception case, the reference network consists of seven transmitters located at the centre and the vertices of a hexagon and is of the closed network type. The power of the central transmitter is reduced by 10 dB with respect to the peripheral transmitters, which have a power of 1 kW. The antenna patterns of the peripheral transmitters have a reduction of the outgoing field strength of 12 dB over 240°. A sharp transition from 0 dB to 12 dB reduction is assumed at the indicated bearings.

TABLE A3-4

Parameters of RN 5 for RPC 4 and RN 6 for RPC 5

RPC	RPC 4	RPC 5
Reception type	Mobile	Portable indoor
Type of network	Closed	closed
Geometry of service area	Hexagon	Hexagon
Number of transmitters	7	7
Geometry of transmitter lattice	Hexagon	Hexagon
Distance between transmitters *d* (km)	60	60
Service area diameter *D* (km)	120	120
Tx effective antenna height (m)	150	150
Peripheral Tx antenna pattern	Directional 12 dB reduction over 240°	Directional 12 dB reduction over 240°
Central Tx antenna pattern	Non-directional	Non-directional
Peripheral Tx e.r.p. (dBW)	30.0	39.0
Central Tx e.r.p. (dBW)	20.0	29.0

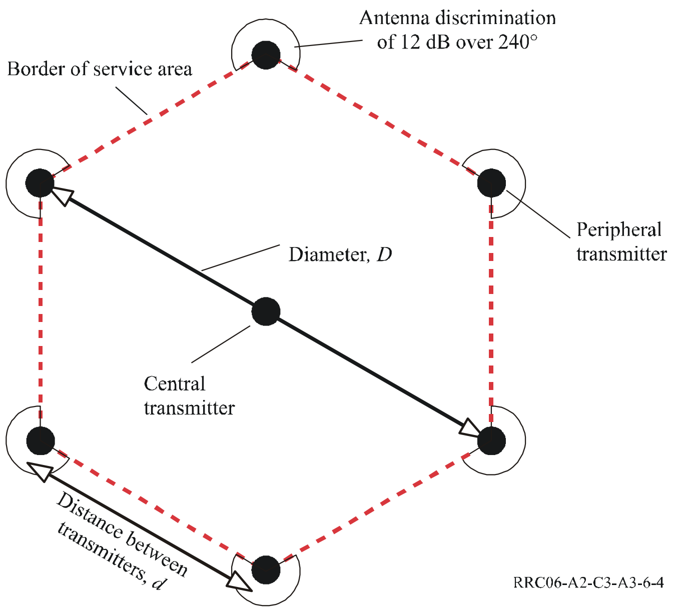
The e.r.p. is given for 200 MHz; for other frequencies (*f* in MHz) the frequency correction factor to be added is: 30 $\log_{10}(f/200)$ for RPC 4 and RPC 5.

For RPC 5, the portable indoor reception case, the same reference network characteristics are used as for RPC 4, apart from the transmitter powers which are increased by 9 dB, corresponding to the higher minimum field strength needed for this reception mode.

The parameters and the power budgets of the RN 5 for RPC 4 and RN 6 for RPC 5 given in Table A3-4 should be used. Fig. A3.6-4 shows the geometry of the RNs.

FIGURE A.3.6-4

Geometry of the RNs for T-DAB



Annex 4

Calculation of minimum field strength and minimum median equivalent field strength

The minimum field strength and minimum median equivalent field strength values calculated using the following equations:

$$P_n = F + 10 \log (k\, T_0\, B)$$

$$P_{s\,min} = C/N + P_n$$

$$A_a = G + 10 \log (1.64\lambda^2/4\,\pi)$$

$$\varphi_{min} = P_{s\,min} - A_a + L_f$$

$$E_{min} = \varphi_{min} + 120 + 10 \log (120\,\pi)$$

$$= \varphi_{min} + 145.8$$

$E_{med} = E_{min} + P_{mmn} + C_l$ for roof top level fixed reception

$E_{med} = E_{min} + P_{mmn} + C_l + L_h$ for portable outdoor and mobile reception

$E_{med} = E_{min} + P_{mmn} + C_l + L_h + L_b$ for portable indoor and mobile hand-held reception

$$C_l = \mu \cdot \sigma_t$$

$$\sigma_t = \sqrt{\sigma_b^2 + \sigma_m^2}$$

where:

P_n : receiver noise input power (dBW)

F : receiver noise figure (dB)

k : Boltzmann's constant ($k = 1.38 \times 10^{-23}$ (J/K))

T_0 : absolute temperature ($T_0 = 290$ (K))

B : receiver noise bandwidth ($B = 7.61 \times 10^6$ (Hz))

$P_{s\,min}$: minimum receiver input power (dBW)

C/N : RF S/N at the receiver input required by the system (dB)

A_a : effective antenna aperture (dBm^2)

G : antenna gain related to half dipole (dBd)

λ : wavelength of the signal (m)

φ_{min} : minimum pfd at receiving place (dB(W/m^2))

L_f : feeder loss (dB)

E_{min} : equivalent minimum field strength at receiving place (dB(μV/m))

E_{med} : minimum median equivalent field strength, planning value (dB(μV/m))

P_{mmn} : allowance for man-made noise (dB)

L_h : height loss (reception point at 1.5 m above ground level) (dB)

L_b : building or vehicle entry loss (dB)

C_l : location correction factor (dB)

σ_t : total standard deviation (dB)

σ_m : standard deviation macro-scale ($\sigma_m = 5.5$ (dB))

σ_b : standard deviation building entry loss (dB)

μ : distribution factor being 0.52 for 70%, 1.28 for 90%, 1.64 for 95% and 2.33 for 99%.

Annex 5

DTTB Link budgets

A5.1 DVB-T

A5.1.1 DVB-T Fixed

DVB-T link budget for fixed roof top reception					
DVB-T transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DVB-T receiver parameters					
Rx Antenna height	m	10.00	10.00	10.00	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	7.00	7.00	7.00	ITU-R BT.1368-13
Effective BW	MHz	6.66	6.66	6.66	ITU-R BT.2036-2
Noise figure (F)	dB	5	5	5	ITU-R BT.1368-13
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	2	2	2	Table 9
Noise power (P_n)	dBm	–98.74	–98.74	–98.74	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	20	20	20	Table 10
Receiver sensitivity (P_{min})	dBm	–78.74	–78.74	–78.74	$P_{min} = P_n$(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 12
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R 1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	$s_T = SQRT(\sigma^2 + \sigma_w^2)$
Loss margin (L_m) 95%	dB	9.05	9.05	9.05	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–69.69	–69.69	–69.69	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBμV /m	46.39	46.39	46.39	
Feeder loss (L_{cable})	dB	2.00	2.00	2.00	Table 11
Antenna gain (G_{iso})	dBi	9.15	9.15	9.15	Table 11
$G_{iso} – L_{cable}$	dBi	7.15	7.15	7.15	Table 11
Urban Height Loss 10 m to 1.5 m	dB	NA	NA	NA	
Suburban Height Loss 10 m to 1.5 m		NA	NA	NA	
Building Entry Loss	dB	NA	NA	NA	
Max allowed path loss (L_p)	dB	152.00	142.00	132.97	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A5.1.2 DVB-T Portable Outdoor

DVB-T link budget for portable outdoor reception					
DVB-T transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DVB-T receiver parameters					
Rx Antenna height	m	1.50	1.50	1.50	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	7.00	7.00	7.00	ITU-R BT.1368-13
Effective BW	MHz	6.66	6.66	6.66	ITU-R BT.2036-2
Noise figure (F)	dB	5	5	5	ITU-R BT.1368-13
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	8	8	8	Table 9
Noise power (P_n)	dBm	–92.74	–92.74	–92.74	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	18	18	18	Table 10
Receiver sensitivity (P_{min})	dBm	–74.74	–74.74	–74.74	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 14
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R 1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m) 95%	dB	9.05	9.05	9.05	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–65.69	–65.69	–65.69	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBµV /m	76.54	76.54	76.54	Urban
Minimum field strength @ 10 m	dBµV /m	69.54	69.54	69.54	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 13
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban Height Loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban Height Loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building Entry Loss	dB	NA	NA	NA	
Max allowed path loss (L_p)	dB	140.85	130.85	121.82	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A5.1.3 DVB-T Portable Indoor

DVB-T link budget for portable indoor reception					
DVB-T transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DVB-T receiver parameters					
Rx Antenna height	m	1.50	1.50	1.50	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	7.00	7.00	7.00	ITU-R BT.1368-13
Effective BW	MHz	6.66	6.66	6.66	ITU-R BT.2036-2
Noise figure (F)	dB	5	5	5	ITU-R BT.1368-13
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	8	8	8	Table 9
Noise power (P_n)	dBm	–92.74	–92.74	–92.74	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	18	18	18	Table 10
Receiver sensitivity (P_{min})	dBm	–74.74	–74.74	–74.74	$P_{min} = P_n$(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 14
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	8.20	8.20	8.20	ITU-R P.2109
Total loss standard deviation (σ_T)	dB	9.87	9.87	9.87	$s_T = SQRT(\sigma^2 + \sigma_w^2)$
Loss margin (L_m) 95%	dB	16.24	16.24	16.24	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–58.50	–58.50	–58.50	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBμV /m	94.23	94.23	94.23	Urban
Minimum field strength @ 10 m	dBμV /m	87.23	87.23	87.23	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 13
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban Height Loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban Height Loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building Entry Loss	dB	10.50	10.50	10.50	ITU-R P.2109
Max allowed path loss (L_p)	dB	133.66	123.66	114.63	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A5.2 DVB-T2

A5.2.1 DVB-T2 Fixed

DVB-T2 link budget for fixed roof top reception					
DVB-T2 transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DVB-T2 receiver parameters					
Rx Antenna height	m	10.00	10.00	10.00	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.2033-1
Channel BW	MHz	7.00	7.00	7.00	ITU-R BT.2033-1
Effective BW	MHz	6.66	6.66	6.66	ITU-R BT.2036-2
Noise figure (F)	dB	6	6	6	ITU-R BT.2033-1
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	2	2	2	Table 9
Noise power (P_n)	dBm	–97.74	–97.74	–97.74	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	20	20	20	Table 10
Receiver sensitivity (P_{min})	dBm	–77.74	–77.74	–77.74	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 12
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	$s_T = SQRT(\sigma^2 + \sigma_w^2)$
Loss margin (L_m) 95%	dB	9.05	9.05	9.05	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–68.69	–68.69	–68.69	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBµV /m	47.39	47.39	47.39	
Feeder loss (L_{cable})	dB	2.00	2.00	2.00	Table 11
Antenna gain (G_{iso})	dBi	9.15	9.15	9.15	Table 11
G_{iso} – L_{cable}	dBi	7.15	7.15	7.15	Table 11
Urban Height Loss 10 m to 1.5 m	dB	NA	NA	NA	
Suburban Height Loss 10 m to 1.5 m		NA	NA	NA	
Building Entry Loss	dB	NA	NA	NA	
Max allowed path loss (L_p)	dB	151.00	141.00	131.97	L_p = EIRP + (G_{iso} – L_{cable}) – L_{wall} – L_{body} – P_{mean}

A5.2.2 DVB-T2 Outdoor

DVB-T2 link budget for portable outdoor reception					
DVB-T2 transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DVB-T2 receiver parameters					
Rx Antenna height	m	1.50	1.50	1.50	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.2033-1
Channel BW	MHz	7.00	7.00	7.00	ITU-R BT.2033-1
Effective BW	MHz	6.66	6.66	6.66	ITU-R BT.2036-2
Noise figure (F)	dB	6	6	6	ITU-R BT.2033-1
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	8	8	8	Table 9
Noise power (P_n)	dBm	–91.74	–91.74	–91.74	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	18	18	18	Table 10
Receiver sensitivity (P_{min})	dBm	–73.74	–73.74	–73.74	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 14
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m) 95%	dB	9.05	9.05	9.05	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–64.69	–64.69	–64.69	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBµV /m	77.54	77.54	77.54	Urban
Minimum field strength @ 10 m	dBµV /m	70.54	70.54	70.54	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 13
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban Height Loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban Height Loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building Entry Loss	dB	NA	NA	NA	
Max allowed path loss (L_p)	dB	139.85	129.85	120.82	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A5.2.3 DVB-T2 Indoor

DVB-T2 link budget for portable indoor reception					
DVB-T2 transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DVB-T2 receiver parameters					
Rx Antenna height	m	1.50	1.50	1.50	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.2033-1
Channel BW	MHz	7.00	7.00	7.00	ITU-R BT.2033-1
Effective BW	MHz	6.66	6.66	6.66	ITU-R BT.2036-2
Noise figure (F)	dB	6	6	6	ITU-R BT.2033-1
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for man made noise	dB	8	8	8	Table 9
Noise power (P_n)	dBm	–91.74	–91.74	–91.74	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	18	18	18	Table 10
Receiver sensitivity (P_{min})	dBm	–73.74	–73.74	–73.74	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 14
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	8.20	8.20	8.20	
Total loss standard deviation (σ_T)	dB	9.87	9.87	9.87	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m) 95%	dB	16.24	16.24	16.24	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–57.50	–57.50	–57.50	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBµV /m	95.23	95.23	95.23	Urban
Minimum field strength @ 10 m	dBµV /m	88.23	88.23	88.23	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 13
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban Height Loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban Height Loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building Entry Loss	dB	10.50	10.50	10.50	ITU-R P.2109
Max allowed path loss (L_p)	dB	132.66	122.66	113.63	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A5.3 ATSC

A5.3.1 ATSC Fixed

ATSC link budget for fixed roof top reception					
ATSC transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	84.19	76.92	72.15	For 160 kW, 30 kW and 10 kW ERP transmitters respectively
Antenna Height Above Average Terrain	m	305.00	610.00	1000.00	§ 3.1.2.1
ATSC receiver parameters					
Rx Antenna height	m	10.00	10.00	10.00	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	6.00	6.00	6.00	ITU-R BT.1368-13
Effective BW	MHz	6	6	6	ITU-R BT.2036-2
Noise figure (F)	dB	10	10	10	Table 18
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	0	0	0	Table 18
Noise power (P_n)	dBm	–96.19	–96.19	–96.19	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	15	15	15	Table 19
Receiver sensitivity (P_{min})	dBm	–81.19	–81.19	–81.19	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	50	50	50	Table 21
Gaussian confidence factor for cell edge coverage probability of 50% ($\mu_{50\%}$)	%	0.00	0.00	0.00	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	$s_T = SQRT(\sigma^2 + \sigma_w^2)$
Loss margin (L_m) 50%	dB	0.00	0.00	0.00	$L_m = \mu_{50\%} * \sigma$
P_{mean} (50%)	dBm	–81.19	–81.19	–81.19	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBμV/m	35.89	35.89	35.89	
Feeder loss (L_{cable})	dB	2.00	2.00	2.00	Table 20
Antenna gain (G_{iso})	dBi	8.15	8.15	8.15	Table 20
G_{iso} – L_{cable}	dBi	6.15	6.15	6.15	Table 20
Urban Height Loss 10 m to 1.5m	dB	NA	NA	NA	
Suburban Height Loss 10 m to 1.5 m		NA	NA	NA	
Building Entry Loss	dB	NA	NA	NA	
Max allowed path loss (L_p)	dB	171.53	164.26	159.49	L_p = EIRP + (G_{iso} – L_{cable}) – L_{wall} – L_{body} – P_{mean}

A5.3.2 ATSC Outdoor

ATSC link budget for portable outdoor reception					
ATSC transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	84.19	76.92	72.15	For 160 kW, 30 kW and 10 kW ERP transmitters respectively
Antenna Height Above Average Terrain	m	305.00	610.00	1000.00	§ 3.1.2.1
ATSC receiver parameters					
Rx Antenna height	m	1.50	1.50	1.50	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	6.00	6.00	6.00	ITU-R BT.1368-13
Effective BW	MHz	6	6	6	ITU-R BT.2036-2
Noise figure (F)	dB	10	10	10	Table 18
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	0	0	0	Table 18
Noise power (P_n)	dBm	–96.19	–96.19	–96.19	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	15	15	15	
Receiver sensitivity (P_{min})	dBm	–81.19	–81.19	–81.19	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	50	50	50	Table 23
Gaussian confidence factor for cell edge coverage probability of 50% ($\mu_{50\%}$)	%	0.00	0.00	0.00	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	$s_T = SQRT(\sigma^2 + \sigma_w^2)$
Loss margin (L_m) 50%	dB	0.00	0.00	0.00	$L_m = \mu_{50\%} * \sigma$
P_{mean} (50%)	dBm	–81.19	–81.19	–81.19	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBµV /m	61.04	61.04	61.04	Urban
Minimum field strength @ 10 m	dBµV /m	54.04	54.04	54.04	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Tabe 22
G_{iso} – L_{cable}	dBi	0.00	0.00	0.00	
Urban Height Loss 10 m to 1.5m	dB	19	19	19	ITU-R P.1546-5
Suburban Height Loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building Entry Loss	dB		0.00	0.00	
Max allowed path loss (L_p)	dB	165.38	158.11	153.34	L_p = EIRP + (G_{iso} – L_{cable}) – L_{wall} – L_{body} – P_{mean}

A5.4 ISDB-T

A5.4.1 ISDB-T Fixed

ISDB-T link budget for fixed roof top reception					
ISDB-T transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	74.19	64.19	54.19	For 16 kW, 1.6 kW and 0.16 kW ERP transmitters respectively
Antenna Height Above Average Terrain	m	150.00	150.00	150.00	§ 3.1.3.1
ISDB-T receiver parameters					
Rx Antenna height	m	10.00	10.00	10.00	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	6.00	6.00	6.00	ITU-R BT.1368-13
Effective BW	MHz	5.6	5.6	5.6	ITU-R BT.1368-13
Noise figure (F)	dB	5	5	5	ITU-R BT.1368-13
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	1	1	1	ITU-R BT.1368-13
Noise power (P_n)	dBm	–100.49	–100.49	–100.49	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	20.1	20.1	20.1	ITU-R BT.2036-2
Receiver sensitivity (P_{min})	dBm	–80.39	–80.39	–80.39	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–71.37	–71.37	–71.37	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBμV /m	47.71	47.71	47.71	
Feeder loss (L_{cable})	dB	3.00	3.00	3.00	Table 28
Antenna gain (G_{iso})	dBi	7.15	7.15	7.15	Table 28
$G_{iso} – L_{cable}$	dBi	4.15	4.15	4.15	Table 28
Urban Height Loss 10 m to 1.5 m	dB	NA	NA	NA	
Suburban Height Loss 10 m to 1.5 m		NA	NA	NA	
Building Entry Loss	dB	NA	NA	NA	
Max allowed path loss (L_p)	dB	149.71	139.71	129.71	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A5.5 DTMB

A5.5.1 DTMB Fixed

DTMB link budget for fixed roof top reception					
DTMB transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DTMB receiver parameters					
Rx Antenna height	m	10.00	10.00	10.00	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	8.00	8.00	8.00	ITU-R BT.1368-13
Effective BW	MHz	7.56	7.56	7.56	ITU-R BT.2036-2
Noise figure (F)	dB	5	5	5	ITU-R BT.1368-13
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	1	1	1	Table 32
Noise power (P_n)	dBm	–99.19	–99.19	–99.19	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	19	19	19	Table 33
Receiver sensitivity (P_{min})	dBm	–80.19	–80.19	–80.19	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 35
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m)	50%	9.02	9.02	9.02	$L_m = \mu 9_{5\%} * \sigma$
P_{mean} (95%)	dBm	–71.17	–71.17	–71.17	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBμV /m	47.91	47.91	47.91	
Feeder loss (L_{cable})	dB	3.00	3.00	3.00	Table 34
Antenna gain (G_{iso})	dBi	7.15	7.15	7.15	Table 34
$G_{iso} – L_{cable}$	dBi	4.15	4.15	4.15	Table 34
Urban Height Loss 10 m to 1.5 m	dB	NA	NA	NA	
Suburban Height Loss 10 m to 1.5 m		NA	NA	NA	
Building Entry Loss	dB	NA	NA	NA	
Max allowed path loss (L_p)	dB	150.48	140.48	131.45	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A5.5.2 DTMB Indoor

DTMB link budget for portable indoor reception					
DTMB transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	75.16	65.16	56.13	For 20 kW, 2 kW and 0.25 kW ERP transmitters respectively
Tx Antenna Effective height	m	300.00	150.00	70.00	
DTMB receiver parameters					
Rx Antenna height	m	1.50	1.50	1.50	ITU-R BT.2036-2
Center frequency	MHz	200.00	200.00	200.00	ITU-R BT.1368-13
Channel BW	MHz	8.00	8.00	8.00	ITU-R BT.1368-13
Effective BW	MHz	7.56	7.56	7.56	ITU-R BT.2036-2
Noise figure (F)	dB	5	5	5	ITU-R BT.1368-13
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	1	1	1	Table 32
Noise power (P_n)	dBm	–99.19	–99.19	–99.19	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	14	14	14	Table 33
Receiver sensitivity (P_{min})	dBm	–85.19	–85.19	–85.19	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R P.1546-5
Building entry loss standard deviation (σ_w)	dB	8.20	8.20	8.20	ITU-R P.2109
Total loss standard deviation (σ_T)	dB	9.87	9.87	9.87	s_T = SQRT($\sigma^2 + \sigma_w{}^2$)
Loss margin (L_m) 95%	dB	16.19	16.19	16.19	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–69.00	–69.00	–69.00	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBμV/m	83.73	83.73	83.73	Urban
Minimum field strength @ 10 m	dBμV/m	76.73	76.73	76.73	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban Height Loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban Height Loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building Entry Loss	dB	10.50	10.50	10.50	ITU-R P.2109
Max allowed path loss (L_p)	dB	144.16	134.16	125.13	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

Annex 6

DSB Link Budgets

A6.1 DAB

A6.1.1 DAB Mobile

DAB link budget for mobile reception					
DAB transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	72.15	62.15	49.14	For 10 kW, 1 kW and 0.05 kW ERP transmitters respectively
Tx antenna effective height	m	300.00	150.00	70.00	
DAB receiver parameters					
Rx antenna height	m	1.50	1.50	1.50	ITU-R BS.2214-3
Centre frequency	MHz	200.00	200.00	200.00	ITU-R BS.2214-3
Channel BW	MHz	1.75	1.75	1.75	ITU-R BS.1660-8
Effective BW	MHz	1.54	1.54	1.54	ITU-R BS.1660-8
Noise figure (F)	dB	6	6	6	ITU-R BS.2214-3
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for man-made noise	dB	0.9	0.9	0.9	ITU-R BS.2214-3
Noise power (P_n)	dBm	-105.20	-105.20	-105.20	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	12.6	12.6	12.6	ITU-R BS.2214-3
Receiver sensitivity (P_{min})	dBm	–92.60	–92.60	–92.60	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	99	99	99	Table 46
Gaussian confidence factor for cell edge coverage probability of 99% ($\mu_{99\%}$)	%	2.33	2.33	2.33	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R 1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m) 99%	dB	12.82	12.82	12.82	$L_m = \mu_{99\%} * \sigma$
P_{mean} (99%)	dBm	–79.78	–79.78	–79.78	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBμV /m	65.30	65.30	65.30	Urban
Minimum field strength @ 10 m	dBμV /m	58.30	58.30	58.30	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	–2.85	–2.85	–2.85	ITU-R BS.2214-3
$G_{iso} – L_{cable}$	dBi	–2.85	–2.85	–2.85	
Urban height loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban height loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building entry loss	dB	0.00	0.00	0.00	
Max allowed path loss (L_p)	dB	149.08	139.08	126.07	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A6.1.2 DAB Portable Indoor

DAB link budget for portable indoor reception					
DAB transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	72.15	62.15	49.14	For 10 kW, 1 kW and 0.05 kW ERP transmitters respectively
Tx antenna effective height	m	300.00	150.00	70.00	
DAB receiver parameters					
Rx antenna height	m	1.50	1.50	1.50	ITU-R BS.2214-3
Centre frequency	MHz	200.00	200.00	200.00	ITU-R BS.2214-3
Channel BW	MHz	1.75	1.75	1.75	ITU-R BS.1660-8
Effective BW	MHz	1.54	1.54	1.54	ITU-R BS.1660-8
Noise figure (F)	dB	6	6	6	ITU-R BS.2214-3
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	5.3	5.3	5.3	ITU-R BS.2214-3
Noise power (P_n)	dBm	–100.80	–100.80	–100.80	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	11.9	11.9	11.9	ITU-R BS.2214-3
Receiver sensitivity (P_{min})	dBm	–88.90	–88.90	–88.90	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 46
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R 1546-5
Building entry loss standard deviation (σ_w)	dB	8.20	8.20	8.20	ITU-R P.2109-0
Total loss standard deviation (σ_T)	dB	9.87	9.87	9.87	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m) 95%	dB	16.19	16.19	16.19	$L_m = \mu_{99\%} * \sigma$
P_{mean} (95%)	dBm	–72.71	–72.71	–72.71	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBµV/m	85.87	85.87	85.87	Urban
Minimum field strength @ 10 m	dBµV/m	78.87	78.87	78.87	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	–5.85	–5.85	–5.85	ITU-R BS.2214-3
$G_{iso} – L_{cable}$	dBi	–5.85	–5.85	–5.85	
Urban height loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban height loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building entry loss	dB	10.50	10.50	10.50	ITU-R P.2109-0
Max allowed path loss (L_p)	dB	139.01	129.01	116.00	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$

A6.1.3 DAB Portable Outdoor

DAB link budget for portable outdoor reception					
DAB transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
EIRP	dBm	72.15	62.15	49.14	For 10 kW, 1 kW and 0.05 kW ERP transmitters respectively
Tx antenna effective height	m	300.00	150.00	70.00	
DAB receiver parameters					
Rx antenna height	m	1.50	1.50	1.50	ITU-R BS.2214-3
Centre frequency	MHz	200.00	200.00	200.00	ITU-R BS.2214-3
Channel BW	MHz	1.75	1.75	1.75	ITU-R BS.1660-8
Effective BW	MHz	1.54	1.54	1.54	ITU-R BS.1660-8
Noise figure (F)	dB	6	6	6	ITU-R BS.2214-3
Boltzmann's constant (k)	Ws/K	1.38E-23	1.38E-23	1.38E-23	
Absolute temperature (T)	K	290	290	290	
Allowance for manmade noise	dB	1.5	1.5	1.5	ITU-R BS.2214-3
Noise power (P_n)	dBm	–104.60	–104.60	–104.60	P_n(dBm) = F+10log(k*T*B*10^6)+30
SNR at cell edge	dB	11.9	11.9	11.9	ITU-R BS.2214-3
Receiver sensitivity (P_{min})	dBm	–92.70	–92.70	–92.70	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	95	95	95	Table 46
Gaussian confidence factor for cell edge coverage probability of 95% ($\mu_{95\%}$)	%	1.64	1.64	1.64	
Shadowing loss standard deviation (σ)	dB	5.50	5.50	5.50	ITU-R 1546-5
Building entry loss standard deviation (σ_w)	dB	0.00	0.00	0.00	
Total loss standard deviation (σ_T)	dB	5.50	5.50	5.50	s_T = SQRT($\sigma^2 + \sigma_w^2$)
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{99\%} * \sigma$
P_{mean} (95%)	dBm	–83.68	–83.68	–83.68	$P_{mean} = P_{min} + L_m$
Minimum field strength @ 10 m	dBµV/m	64.40	64.40	64.40	Urban
Minimum field strength @ 10 m	dBµV/m	57.40	57.40	57.40	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	–5.85	–5.85	–5.85	ITU-R BS.2214-3
$G_{iso} – L_{cable}$	dBi	–5.85	–5.85	–5.85	
Urban height loss 10 m to 1.5 m	dB	19	19	19	ITU-R P.1546-5
Suburban height loss 10 m to 1.5 m	dB	12	12	12	ITU-R P.1546-5
Building entry loss	dB	0.00	0.00	0.00	
Max allowed path loss (L_p)	dB	149.98	139.98	126.97	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{body} – P_{mean}$