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Typical frequency sharing characteristics for digital terrestrial broadcasting systems in the frequency band 174-230 MHz

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REPORT ITU-R BT.2469-3

Typical frequency sharing characteristics for digital terrestrial broadcasting systems in the frequency band 174-230 MHz

(2019-03/2021-11/2021-2023)

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1 Introduction

This Report contains a summary of the reference frequency sharing characteristics of Band III (174-230 MHz) digital terrestrial broadcasting (DTB) systems, television and sound, required for relevant compatibility studies[1].

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 DTTB receiving 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 e.r.p. 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

[1] Characteristics of Band IV/V broadcast systems can be found in Report ITU-R BT.2383 – Typical frequency sharing characteristics of digital terrestrial television systems in the frequency band 470-862 MHz.

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[2], 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.

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[3].

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.

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

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

Which in the case of:

– DVB-T, ATSC 1.0 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, ATSC 3.0, DTMB and DTMB-A, this corresponds to BER less than 10^{-7} before BCH decoder or BER less than 10^{-11} after BCH decoder.[4]

Any study of interference into a DTTB system must take account of QEF and the hour time window. Information on the use of Monte Carlo simulation to model interference to DTTB and application of a time window can be found in Report ITU-R BT.2470[5] and Recommendation ITU-R BT.2136[6].

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).

A simplification of the spectrum planning process[7] 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.

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[4] For ATSC 3.0, this and other BERs are achievable by selecting different options, such as CRC, BCH, or no outer-FEC.

[5] Report ITU-R BT.2470 – Use of Monte Carlo simulation to model interference to DTTB.

[6] Recommendation ITU-R BT.2136 – Assessing interference into digital terrestrial television broadcasting from other services by means of Monte Carlo simulation.

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

FIGURE 1A

Original area covered

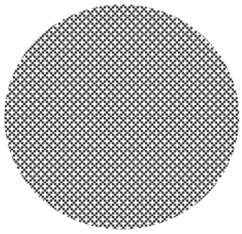


FIGURE 1B

Reduction in area covered (relaxation of one factor)

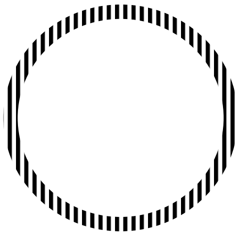
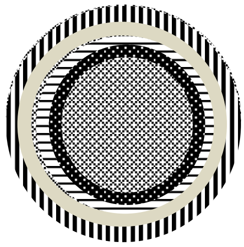


FIGURE 1C

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.

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

Attachment 3 to Annex 2 to Report ITU-R BT.2265 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, § 3.2 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 Out-of-band masks

Information on DTTB transmitter spectrum masks to be used in compatibility studies is provided in Recommendation ITU-R BT.1206.

3.1.2 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.

3.1.2.1 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:

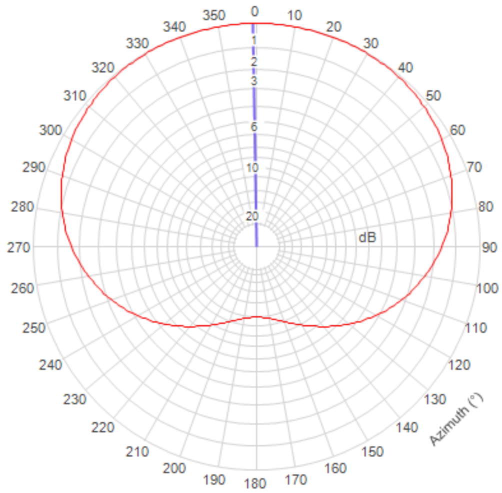
ϑ : azimuth angle

k : 0.4187 for 10 dB pattern minima.

The resulting pattern is shown in Fig. 2.

FIGURE 2

Low power DTTB



Unlike high and medium power antennas which are usually omnidirectional, few low power DTTB antenna are omnidirectional. Low power DTTB 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 DTTB 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.

3.1.2.2 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:

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

3.1.3 ATSC Reference broadcasting networks

Reference broadcast transmitter configurations are provided that are representative of actual deployments[8]. The configurations depend on both the 'system-independent' planning factors and the 'system dependent' planning factors, that were used in regulatory allotments by those countries adopting the system. Included are such factors as the maximum power permitted in a 6 MHz channel, the maximum height (HAAT) at which that power level can be used, threshold signal levels for reception in the several television broadcast frequency bands, and so forth. There is only a single operating point with respect to the required signal-to-noise ratio for the threshold of reception at a specific bitrate.

3.1.3.1 DTTB System A (ATSC 1.0) or System S (ATSC 3.0) 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

[8] Values are derived from the Consolidated Data Base System (CDBS). This system was the predecessor to the Licensing and Management System (LMS) of the FCC currently in use and available at: https://enterprisefiling.fcc.gov/dataentry/login.html

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. Administrations should consider local and regional requirements when establishing an appropriate propagation model for DTTB coverage.

3.1.3.2 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 2 are to be used for sharing studies[9].

TABLE 2

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:

$$Reduction\ in\ dB = 20 * \log 10(Relative\ Field\ Strength)$$

3.1.4 ISDB-T Reference broadcasting networks

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

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

3.1.4.1 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

3.1.4.2 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:

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

3.1.5 DTMB Reference broadcasting networks

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

3.1.5.1 DTTB System D (DTMB) single transmitter

- High power
  - ERP: 20 kW
  - 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

3.1.5.2 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:

$$Reduction\ in\ dB = 20 * \log 10\{E(\theta)\}$$

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

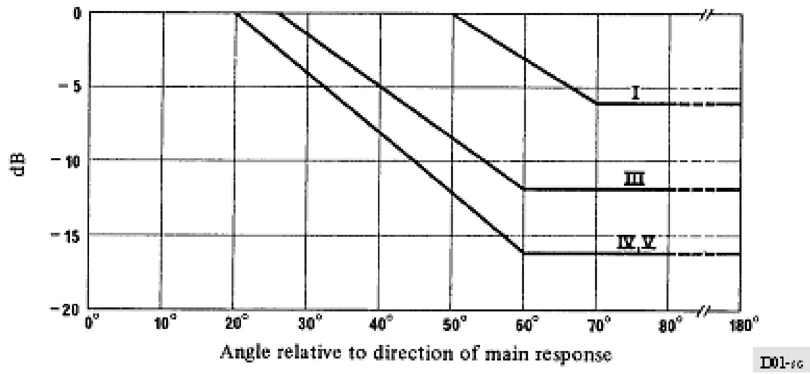
The reference receiving antenna height considered to be representative in calculating the field strength for fixed reception is 10 m above ground level.

3.2.1.2 Fixed antenna radiation pattern

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

FIGURE 3

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[10].

3.2.1.5 Height loss correction

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

However, in broadcasting, it is common practice for fixed reception to calculate the field strength at 10 m, or at the height of the surrounding clutter if it is greater than 10m, for example in an urban environment[11]. In some cases, a 10 m reference height is also used as the starting point in calculations for portable and mobile reception with an appropriate height loss taken into account to derive the required value at 1.5 m.

The height-loss values for portable and for mobile reception for reference frequencies are given in Table 3.

TABLE 3

Suburban and urban height loss in Band III[12]

Frequency (MHz)	200
Suburban height loss (dB) (10 m terminal and clutter height to 1.5 m receiver height)	12
Urban height loss (dB) (20 m terminal and clutter height to 1.5 m receiver height)	19

[10] Recommendations ITU-R BT.1368 and ITU-R BT.2033.

[11] See Recommendation ITU-R P.1546, Annex 5 § 9.

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

3.2.1.6 Building entry loss

The methodology described in Recommendation ITU-R P.2109 for calculating building loss should be used in sharing and compatibility studies involving broadcast systems.

Recommendation ITU-R P.2109 covers a full range of building types of traditional and thermally efficient construction. For sharing and compatibility studies, involving broadcast systems, that use Recommendation ITU-R P.2109, whenever a single representative value is required (for example, in an MCL analysis), the parameters provided in Table 4 should be used. This is independent of coverage planning. For dynamic or statistical analysis (for example, in a Monte Carlo simulation), the full distribution function of Recommendation ITU-R P.2109 should be used.

TABLE 4

P.2109 Broadcast building entry loss parameters to use in sharing and compatibility studies

Building type	**Environment**	**Probability building entry loss not exceeded**
Traditional	Suburban	50%
Traditional	Urban	70%

NOTE – Studies of building entry loss have meant figures have changed over time with the current version of Recommendation ITU-R P.2109 representing the latest work. The parameters specified in Table 4 provide a building entry loss aligned with values derived using parameters supplied in older documents, for example Recommendation ITU-R P.1812 and the low building class in Recommendation ITU-R BT.2033-1.

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:

$$Corr = 10\log(F_A/F_R)$$

where:

Corr : correction term

F_A : actual working frequency being considered

F_R : 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[13]

Recommendation ITU-R P.1546, 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.

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

3.2.2.1 General parameters

TABLE 5

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) Recommendation ITU-R BT 1368, Table 53.

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

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

3.2.2.2 Carrier to noise

Within GE06, Recommendations ITU-R BT.1368 for DVB-T and ITU-R BT.2033 for DVB-T2, carrier to noise figures are provided. For compatibility and sharing studies the values in Table 6 should be used for both systems.

TABLE 6

Carrier-to-noise ratio DVB-T and 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.

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13 Also referred to as variability due to shadowing – shadow loss fading.

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 7.

TABLE 7

Antenna gain (relative to a half-wave dipole) in Band 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, 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 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[14].

3.2.2.3.3 Location probability – fixed reception

For fixed reception, the location probability as given in Table 8 should be used.

TABLE 8

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.

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[14] Refer to Recommendation ITU-R BT 419.

3.2.2.4.1 Portable receive antenna gain

Recommendations ITU-R BT.1368 in its Annex 6, § 4.1 and ITU-R BT.2033 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 9 should be used for both systems.

TABLE 9

Antenna gain (dBd) for portable reception

Band	Gain (dBd)
Band III	–2.15 (1)

(1) 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[15].

3.2.2.4.3 Location probability – portable reception

For portable reception, the location probability as given in Table 10 should be used.

TABLE 10

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 11

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 dB(μV/m)	69.5 dB(μV/m)	87.2 dB(μV/m)

15 Recommendation ITU-R BT.1368.

TABLE 12

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 dB(μV/m)	70.5 dB(μV/m)	88.2 dB(μV/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 13

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 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.

3.2.2.9 Correction of protection ratio figures for different ACLR values

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

3.2.3 ATSC 1.0/ATSC 3.0 – System specific receive parameters

3.2.3.1 General parameters

TABLE 14

General ATSC VHF parameters

Parameter	
Channel bandwidth (MHz)	6
Thermal noise density (kT_0) (dBm/Hz)	–173.98
Receiver noise figure (dB)[16]	10
Man-made noise (dB)[17]	0

3.2.3.2 Carrier to noise

TABLE 15

Carrier-to-noise ratio[18]

Fixed reception	Portable reception
15.0 dB	15.0 dB

3.2.3.3 Fixed antenna system gain

For fixed outdoor 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 16.

TABLE 16

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.

16 A worst-case noise figure in consumer products of 4.5 dB is specified in standards such as CTA-2032-C, and this value can be expected to further improve over time. As this value is likely to be ephemeral, the legacy values used in this Report for this and other systems have not been revised typographically.

17 The increased deployment of incidental radiators has increased man-made noise in the VHF band. An NTIA report shows that in residential areas, total man-made and natural noise adds several dB to this figure. We should expect this value to continue to increase over time.

18 This is measured at the receiver input terminals. For ATSC 3.0, this value represents a specific modulation/coding operating point that is equivalent to the operating point provided by the ATSC 1.0 system.

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 17 should be used.

TABLE 17

Location probability for fixed reception

System	ATSC 1.0/ATSC 3.0
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 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 18.

TABLE 18

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[19].

3.2.3.9 Location probability – portable reception

For portable indoor and outdoor reception, the location probability as given in Table 19 should be used[20].

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[19] Recommendation ITU-R BT.1368.

[20] The location probability and time percentage recommendations used in different regions are known to differ due to local regulatory environments and other considerations.

TABLE 19

Location probability for portable reception

System	ATSC 1.0/ATSC 3.0
Location probability (%)	50

3.2.3.10 Minimum field strength at 200 MHz

TABLE 20

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 dB(μV/m)	64.5 dB(μV/m)

3.2.3.11 Link budgets

Link budgets for ATSC 1.0 and ATSC 3.0 systems for fixed rooftop and portable outdoor reception are provided in Annex 5.

3.2.3.12 Signal time percentage

For portable indoor and outdoor reception, the time percentages as given in Table 21 should be used[20].

TABLE 21

Time percentages used for sharing and compatibility studies

System	Wanted field strength	Interfering field strength
ATSC 1.0/ATSC 3.0	90%[21]	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, and Annex 7 to Recommendation ITU-R BT.2033, respectively.

3.2.3.14 Correction of protection ratio figures for different ACLR values

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

3.2.3.15 Other References

Additional information referred to in this section can be found in the following document:

– NTIA Report 02-390, Man-Made Noise Power Measurements at VHF and UHF Frequencies, U.S. Department of Commerce, December 2001.

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[21] $\text{Field strength } (90\%) = \text{field strength } (50\%) - \{\text{field strength}(10\%) - \text{field strength } (50\%)\}$.

3.2.4 ISDB-T – System specific receive parameters

3.2.4.1 General parameters

TABLE 22

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 23

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 24.

TABLE 24

Antenna gain (relative to a half-wave dipole) in Band 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 25 should be used.

TABLE 25

Location probability for fixed reception

System	ISDB-T
Location probability (%)	95

3.2.4.6 Minimum field strength at 200 MHz

TABLE 26

Minimum field strength at f_r = 200 MHz

Fixed reception at 10 m for 95% location probability
47.6 dB(μV/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.

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 27

Time percentages used for sharing and compatibility studies

System	Wanted field strength	Interfering field strength
ISDB-T	90%[22]	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.

3.2.4.10 Correction of protection ratio figures for different ACLR values

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

[22] $\text{Field strength }(90\%) = \text{field strength }(50\%) - \{\text{field strength}(10\%) - \text{field strength }(50\%)\}$.

3.2.5 DTMB – System specific receive parameters

3.2.5.1 General parameters

TABLE 28

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[23] (dB)	5
Allowance for manmade noise (dB)	1

3.2.5.2 Carrier to noise

TABLE 29

Carrier-to-noise ratio

Fixed reception	Portable reception
19 dB	14 dB

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 30.

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

TABLE 30

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.

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

– 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[24].

3.2.5.5 Location probability – fixed reception

For fixed reception, the location probability as given in Table 31 should be used.

TABLE 31

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.

3.2.5.7 Portable receive antenna gain

Recommendation ITU-R BT.1368 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 32.

TABLE 32

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 33 should be used.

[24] Refer to Recommendation ITU-R BT.419.

TABLE 33

Location probability for portable reception

System	DTMB
Location probability (%)	95

3.2.5.10 Minimum field strength at 200 MHz

TABLE 34

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 dB(μV/m)	83.7 dB(μV/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 35

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:

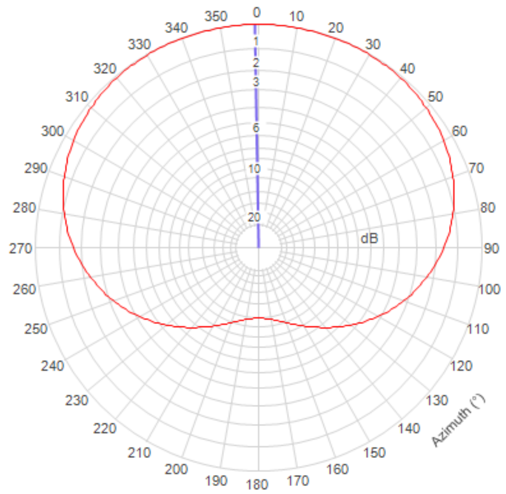
ϑ : azimuth angle

k : 0.4187 for 10 dB pattern minima.

The resulting pattern is shown in Fig. 4.

FIGURE 4

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 = antenna vertical aperture in wavelengths

β = 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:

$$Reduction\ in\ dB = 20 * \log 10\{E(\theta)\}$$

4.1.1.3 Out-of-band mask

Information on DAB transmitter spectrum masks to be used in compatibility studies is provided in Recommendation ITU-R BS.1660.

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 § 3.

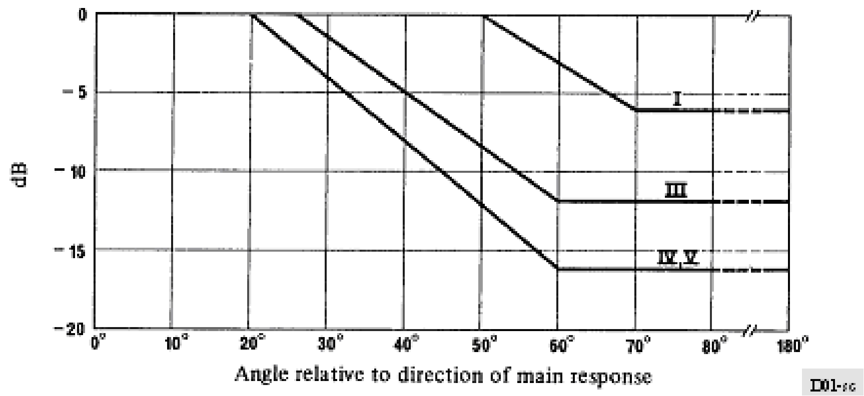
4.2.1.2 Fixed antenna radiation pattern

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

FIGURE 5

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[25].

4.2.1.5 Height loss correction

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

However, in broadcasting, it is common practice for fixed reception to calculate the field strength at 10 m, or at the height of the surrounding clutter if it is greater than 10 m, for example in an urban environment[26]. In some cases, a 10 m reference height is also used as the starting point in calculations for portable and mobile reception with an appropriate height loss taken into account to derive the required value at 1.5 m.

The height-loss values for portable and for mobile reception for reference frequencies are given in Table 36.

[25] Recommendation ITU-R BS.1660.

[26] See Recommendation ITU-R P.1546, Annex 5 § 9.

TABLE 36

Suburban and Urban height loss in Bands III[27]

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

4.2.1.6 Building entry loss

The methodology described in Recommendation ITU-R P.2109 for calculating building loss should be used in sharing and compatibility studies involving broadcast systems.

Recommendation ITU-R P.2109 covers a full range of building types of traditional and thermally efficient construction. For sharing and compatibility studies, involving broadcast systems, that use Recommendation ITU-R P.2109, whenever a single representative value is required (for example, in an MCL analysis), the parameters provided in Table 37 should be used. This is independent of coverage planning. For dynamic or statistical analysis (for example, in a Monte Carlo simulation), the full distribution function of Recommendation ITU-R P.2109 should be used.

TABLE 37

P.2109 Broadcast building entry loss parameters to use in sharing and compatibility studies

Building Type	**Environment**	**Probability building entry loss not exceeded**
Traditional	Suburban	50%
Traditional	Urban	70%

NOTE – Studies of building entry loss have meant figures have changed over time with the current version of Recommendation ITU-R P.2109 representing the latest work. The parameters specified in Table 37 provide a building entry loss aligned with values derived using parameters supplied in older documents, for example Recommendation ITU-R P.1812.

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:

$$Corr = 10\log(F_A/F_R)$$

where:

- $Corr$: correction term
- F_A : actual working frequency being considered
- F_R : reference frequency.

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

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

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.

4.2.2 DAB – System specific receive parameters

4.2.2.1 General parameters

TABLE 38

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, § 7.2.1.

(2) Report ITU-R BS.2214, § 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 39.

TABLE 39

Carrier-to-noise ratio(1)

Portable reception	Mobile reception
11.9 dB	12.6

(1) Report ITU-R BS.2214, 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 40.

TABLE 40

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

Portable (dBd)	Mobile (dBd)
–8	–5

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

Note: The antenna 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 41

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 42

DAB Minimum field strength at f_r=200 MHz

Mobile reception for 99% location probability at 10 m a.g.l.	Portable outdoor reception for 95% location probability at 10 m a.g.l.	Portable indoor reception for 95% location probability at 10 m a.g.l.
56.8 dB(μV/m)	57 dB(μV/m)	79.7 dB(μV/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.

4.2.2.10 Correction of protection ratio figures for different ACLR values

Recommendation ITU-R BT.1368 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 BS.1660 – Technical basis for planning of terrestrial digital sound broadcasting in the VHF band

– 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.1206 – Spectrum limit masks for digital terrestrial television broadcasting

– 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 BS.2214 – Planning parameters for terrestrial digital sound broadcasting systems in VHF bands

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

– Report ITU-R BT.2295 – Digital terrestrial broadcasting systems

– Final Acts of RRC06 – The GE06 Agreement[28]

– 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

[28] 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 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.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:

– Recommendation ITU-R BS.1660 – Technical basis for planning of terrestrial digital sound broadcasting in the VHF band
– Recommendation ITU-R BT.1368 – Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands
– 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
– Recommendation ITU-R BT.2036 – Characteristics of a reference receiving system for frequency planning of digital terrestrial television 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.

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

– Recommendation ITU-R BT.2136 – Assessing interference into digital terrestrial television broadcasting from other services by means of Monte Carlo simulation
– 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
– Report ITU-R BT.2470 – Use of Monte Carlo simulation to model interference to DTTB.

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
– Recommendation ITU-R P.1812 – A path-specific propagation prediction method for point-to-area terrestrial services in the VHF and UHF bands.

Annex 2

General definitions

A2.1 Broadcasting coverage area and service area planning

Recommendation ITU-R V.573 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 neighbours 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 section 2 as *the percentage of locations within a small area, referred in this document as* "*pixel*"[29]*, 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 ITU-R BT.2265 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 DTTB Single frequency networks (Allotments)[(GE06)]

Three reference networks (RN) for DTTB 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.

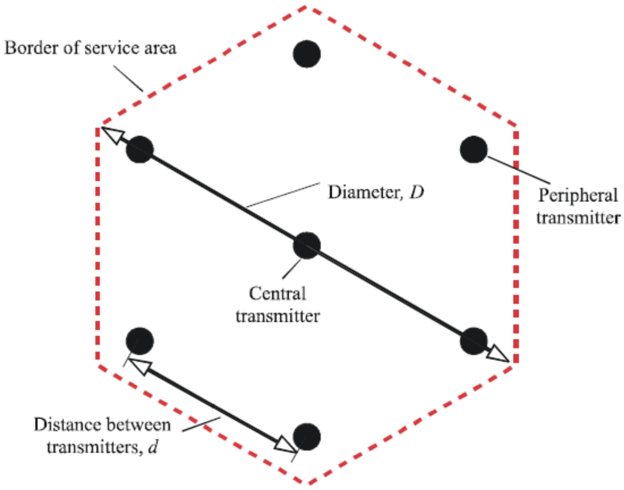
[29] Pixel is a small area of typically about 100 m × 100 m where the percentage of covered receiving locations is indicated.

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 1 (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 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

TABLE A3-1 *(end)*

RPC and reception type	RPC 1 fixed antenna	RPC 2 portable outdoor and mobile	RPC 3 portable indoor
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

(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.

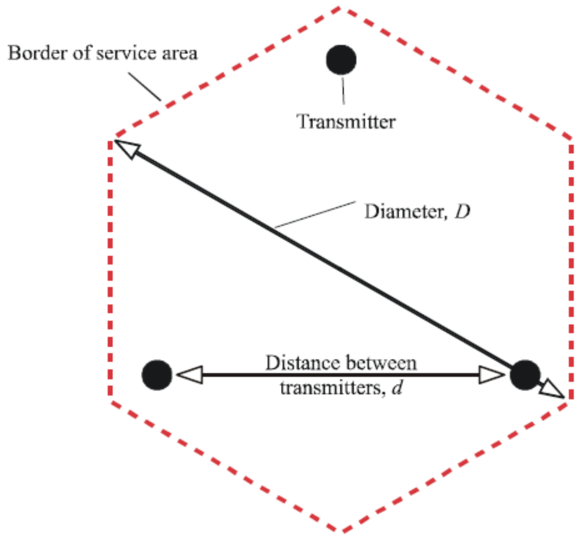
This reference network 2 (RN 2) is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for Band III.

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

TABLE A3-3 *(end)*

RPC and reception type		**RPC 1 fixed antenna**	**RPC 2 portable outdoor and mobile**	**RPC 3 portable indoor**
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

TABLE A3-4 *(end)*

RPC	RPC 4	RPC 5
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

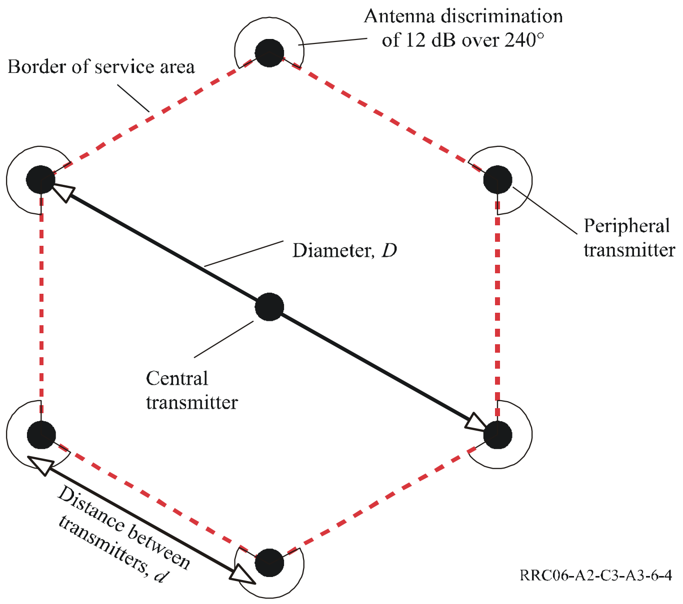
The e.r.p. is given for 200 MHz; for other frequencies (*f* in MHz) the frequency correction factor to be added is: 30 $\log_{10}(f/200)$ for RPC 4 and RPC 5.

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. Figure A3-3 shows the geometry of the RNs.

FIGURE A3-3

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**
e.i.r.p.	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
Centre 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)	J/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 8
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 1546-6
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	−69.72	−69.72	−69.72	$P_{mean} = P_{min} + L_m$
Minimum field strength at receive antenna	dB(μV/m)	46.39	46.39	46.39	
Feeder loss (L_{cable})	dB	2.00	2.00	2.00	Table 7
Antenna gain (G_{iso})	dBi	9.15	9.15	9.15	Table 7
$G_{iso} – L_{cable}$	dBi	7.15	7.15	7.15	Table 7
Max allowed path loss (L_p)	dB	152	142	133	L_p = EIRP + ($G_{iso} – L_{cable}$) – 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**
e.i.r.p.	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
Centre 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)	J/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 5
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 10
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 1546-6
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	−65.72	−65.72	−65.72	$P_{mean} = P_{min} + L_m$
Minimum field strength at 20 m	dB(µV/m)	76.5	76.5	76.5	Urban
Minimum field strength at 10 m	dB(µV/m)	69.5	69.5	69.5	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 9
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban height loss 20 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban 20m max path loss (L_p)	dB	121	111	102	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{height} – P_{mean}$
Suburban 10m max path loss (L_p)	dB	128	118	109	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{height} – P_{mean}$

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**
e.i.r.p.	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
Centre 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)	J/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 5
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 10
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.1546-6
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	−65.72	−65.72	−65.72	$P_{mean} = P_{min} + L_m$
Minimum field strength at 20 m	dB(μV/m)	94.10	94.10	94.10	Urban
Minimum field strength at 10 m	dB(μV/m)	83.50	83.50	83.50	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 9
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban height loss 20 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban building entry loss (p=70%) (L_{wall})	dB	17.6	17.6	17.6	Table 4
Suburban building entry loss (p=50%) (L_{wall})	dB	14	14	14	Table 4
Urban 20 m max path loss (L_p)	dB	104	94	85	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{height} – P_{mean}$
Suburban 10 m max path loss (L_p)	dB	114	104	95	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{height} – P_{mean}$

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**
e.i.r.p.	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
Centre 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)	J/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 5
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 6
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 8
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.1546-6
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	−68.72	−68.72	−68.72	$P_{mean} = P_{min} + L_m$
Minimum field strength at receive antenna	dB(μV/m)	47.35	47.35	47.35	
Feeder loss (L_{cable})	dB	2.00	2.00	2.00	Table 7
Antenna gain (G_{iso})	dBi	9.15	9.15	9.15	Table 7
$G_{iso} – L_{cable}$	dBi	7.15	7.15	7.15	Table 7
Max allowed path loss (L_p)	dB	151	141	132	L_p = EIRP + ($G_{iso} – L_{cable}$)– 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**
e.i.r.p.	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
Centre 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)	J/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 5
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 6
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 10
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.1546-6
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	$s_T = \text{SQRT}(\sigma^2 + \sigma_w^2)$
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	−64.72	−64.72	−64.72	$P_{mean} = P_{min} + L_m$
Minimum field strength at 10 m	dB(μV/m)	77.50	77.50	77.50	Urban
Minimum field strength at 10 m	dB(μV/m)	70.50	70.50	70.50	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 9
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban height loss 10 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban 20 m max path loss (L_p)	dB	120	110	101	L_p = EIRP + ($G_{iso} – L_{cable}$) – L_{height} – P_{mean}
Suburban 10 m max path loss (L_p)	dB	127	117	108	L_p = EIRP + ($G_{iso} – L_{cable}$) – L_{height} – 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**
e.i.r.p.	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
Centre 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)	J/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 5
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 10
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.1546-6
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	−64.72	−64.72	−64.72	$P_{mean} = P_{min} + L_m$
Minimum field strength at 20 m	dB(μV/m)	95.10	95.10	95.10	Urban
Minimum field strength at 10 m	dB(μV/m)	84.50	84.50	84.50	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 9
$G_{iso} – L_{cable}$	dBi	0.00	0.00	0.00	
Urban height loss 10 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban building entry loss (P=70%) (L_{wall})	dB	17.6	17.6	17.6	Table 4
Suburban building entry loss (P=50%) (L_{wall})	dB	14	14	14	Table 4
Urban 20 m max path loss (L_p)	dB	103	93	84	$L_p = EIRP + (G_{iso} – L_{cable}) – L_{wall} – L_{height} – P_{mean}$
Suburban 10 m max path loss (L_p)	dB	113	103	94	$L_p = EIRP + (G_{iso} – L_{cable}) – L_{wall} – L_{height} – P_{mean}$

A5.3 ATSC 1.0/ATSC 3.0

A5.3.1 ATSC fixed[30]

ATSC link budget for fixed roof top reception					
ATSC transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
e.i.r.p.	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
Centre 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 14
Boltzmann's constant (k)	J/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 14
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 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 17
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.1546-6
Loss margin (L_m) 50%	dB	0.00	0.00	0.00	$L_m = \mu_{50\%} * \sigma$
P_{mean} (50%)	dBm	−81.20	−81.20	−81.20	$P_{mean} = P_{min} + L_m$
Minimum field strength at 10 m	dB(μV/m)	35.87	35.87	35.87	
Feeder loss (L_{cable})	dB	2.00	2.00	2.00	Table 16
Antenna gain (G_{iso})	dBi	8.15	8.15	8.15	Table 16
$G_{iso} – L_{cable}$	dBi	6.15	6.15	6.15	Table 16
Max allowed path loss (L_p)	dB	171.53	164.26	159.49	L_p = EIRP + ($G_{iso} – L_{cable}$) – P_{mean}

[30] The values in this and the following table are appropriate for ATSC 3.0 when the modulation and coding parameters are set to produce a *C*/*N* threshold equal to that of ATSC 1.0.

A5.3.2 ATSC 1.0/ATSC 3.0 outdoor

ATSC link budget for portable outdoor reception					
ATSC transmitter parameters					
	Unit	**High power transmitter**	**Medium power transmitter**	**Low power transmitter**	**Notes**
e.i.r.p.	dBm	84.19	76.92	72.15	For 160 kW, 30 kW and 10 kW e.r.p. 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
Centre 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 14
Boltzmann's constant (k)	J/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	−81.20	−81.20	−81.20	P_{min} = P_n(dBm) + SNR(dB)
Cell edge coverage probability	%	50	50	50	Table 19
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.1546-6
Loss margin (L_m) 50%	dB	0.00	0.00	0.00	$L_m = \mu_{50\%} * \sigma$
P_{mean} (50%)	dBm	−81.20	−81.20	−81.20	$P_{mean} = P_{min} + L_m$
Minimum field strength at 20 m	dB(μV/m)	61.02	61.02	61.02	Urban
Minimum field strength at 10 m	dB(μV/m)	54.02	54.02	54.02	Suburban
Feeder loss (L_{cable})	dB	0.00	0.00	0.00	
Antenna gain (G_{iso})	dBi	0.00	0.00	0.00	Table 18
$G_{iso} - L_{cable}$	dBi	0.00	0.00	0.00	
Urban height loss 10 m to 1.5m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban 20 m max path loss (L_p)	dB	146	139	134	L_p = EIRP + ($G_{iso} - L_{cable}$) – $L_{height} - P_{mean}$
Suburban 10 m max path loss (L_p)	dB	153	146	141	L_p = EIRP + ($G_{iso} - L_{cable}$) – $L_{height} - P_{mean}$

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**
e.i.r.p.	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
Centre 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)	J/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.1546-6
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 at 10 m	dB(μV/m)	47.71	47.71	47.71	
Feeder loss (L_{cable})	dB	3.00	3.00	3.00	Table 24
Antenna gain (G_{iso})	dBi	7.15	7.15	7.15	Table 24
$G_{iso} – L_{cable}$	dBi	4.15	4.15	4.15	Table 24
Max allowed path loss (L_p)	dB	149.71	139.71	129.71	L_p = EIRP + ($G_{iso} – L_{cable}$) – 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**
e.i.r.p.	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
Centre 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)	J/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 28
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 31
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.1546-6
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 at 10 m	dB(μV/m)	47.91	47.91	47.91	
Feeder loss (L_{cable})	dB	3.00	3.00	3.00	Table 30
Antenna gain (G_{iso})	dBi	7.15	7.15	7.15	Table 30
$G_{iso} – L_{cable}$	dBi	4.15	4.15	4.15	Table 30
Max allowed path loss (L_p)	dB	150	140	131	$L_p = EIRP + (G_{iso} – L_{cable}) – P_{mean}$

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**
e.i.r.p.	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
Centre 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)	J/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 28
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 29
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.1546-6
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{95\%} * \sigma$
P_{mean} (95%)	dBm	–76.17	–76.17	–76.17	$P_{mean} = P_{min} + L_m$
Minimum field strength at 20 m	dB(μV/m)	83.65	83.65	83.65	Urban
Minimum field strength at 10 m	dB(μV/m)	73.05	73.05	73.05	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 20 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban Height Loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban building entry loss (P=70%) (L_{wall})	dB	17.6	17.6	17.6	Table 4
Suburban building entry loss (P=50%) (L_{wall})	dB	14	14	14	Table 4
Urban 20 m max path loss (L_p)	dB	114	104	95	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{height} – P_{mean}$
Suburban 10 m max path loss (L_p)	dB	125	115	106	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{wall} – L_{height} – P_{mean}$

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**
e.i.r.p.	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)	J/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 41
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 1546-6
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 at 10 m	dB(μV/m)	65.30	65.30	65.30	Urban
Minimum field strength at 10 m	dB(μV/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 20 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban 20 m max path loss (L_p)	dB	130	120	107	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{height} – P_{mean}$
Suburban 10 m max path loss (L_p)	dB	137	127	114	L_p = EIRP + ($G_{iso} – L_{cable}$) – $L_{height} – P_{mean}$

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**
e.i.r.p.	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)	J/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 41
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 1546-6
Loss margin (L_m) 95%	dB	9.02	9.02	9.02	$L_m = \mu_{99\%} * \sigma$
P_{mean} (95%)	dBm	–79.88	–79.88	–79.88	$P_{mean} = P_{min} + L_m$
Minimum field strength at 20 m	dB(µV/m)	85.79	85.79	85.79	Urban
Minimum field strength at 10 m	dB(µV/m)	75.19	75.19	75.19	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 20 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban Building entry loss (P=70%) (L_{wall})	dB	17.6	17.6	17.6	Table 37
Suburban Building entry loss (P=50%) (L_{wall})	dB	14	14	14	Table 37
Urban 20 m max path loss (L_p)	dB	109	99	86	L_p = EIRP + ($G_{iso} – L_{cable}$) – L_{wall} – L_{height} – P_{mean}
Suburban 10 m max path loss (L_p)	dB	120	109	97	L_p = EIRP + ($G_{iso} – L_{cable}$) – L_{wall} – L_{height} – 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**
e.i.r.p.	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)	J/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 41
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 1546-6
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 at 10 m	dB(µV/m)	64.40	64.40	64.40	Urban
Minimum field strength at 10 m	dB(µV/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 20 m to 1.5 m (L_{height})	dB	19	19	19	ITU-R P.1546-6
Suburban height loss 10 m to 1.5 m (L_{height})	dB	12	12	12	ITU-R P.1546-6
Urban 20 m max path loss (Lp)	dB	131	121	109	Lp = EIRP + (Giso – Lcable) – Lheight – Pmean
Urban 20 m max path loss (Lp)	dB	138	128	115	Lp = EIRP + (Giso – Lcable) – Lheight – Pmean

Annex 7

List of abbreviations

Abbreviation	Description
ACLR	Adjacent channel leakage ratio
a.g.l.	Above ground level
ATSC 1.0	Advanced Television Systems Committee standard
ATSC 3.0	Advanced Television Systems Committee standard
BCH	Bose-Chaudhuri-Hocquenghem code
BER	Bit error rate
BS	Base station
CDBS	Consolidated data base system
C/N	Carrier-to-noise ratio
CRC	Cyclic redundancy check
dB	Decibel
dBd	Decibel relative to a dipole
dBi	Decibel relative to an isotropic radiator
dBm	Decibel relative to a milliwatt
dBW	Decibel relative to a watt
dB(μV/m)	Decibel relative to a micro-volt per metre
DAB	Digital audio broadcasting
DSB	Digital sound broadcasting
DTB	Digital terrestrial broadcasting
DTTB	Digital terrestrial television broadcasting
DTMB	Digital terrestrial multimedia broadcast
DTMB-A	Digital terrestrial multimedia broadcast – 2nd Generation
DVB-T	Digital video broadcasting – Terrestrial
DVB-T2	Digital video broadcasting – Second generation Terrestrial
ERP	Effective radiated power
FCC	U.S. Federal Communications Commission
FEC	Forward error correction
FFT	Fast Fourier Transform
GE06	Geneva 06 Radio Regional Conference
HAAT	Height above average terrain
HRP	Horizontal radiation Pattern
Hz	Hertz
I/N	Interference to noise ratio
IMT	International Mobile Telecommunications
ISDB-T	Integrated services digital broadcasting – Terrestrial

Abbreviation	Description
k	Boltzmann's constant
km	Kilometre
kW	Kilowatt
LDPC	Low density parity check code
LMS	Licensing and management system
MBit/s	Megabits per second
MHz	Megahertz
NTIA	National Telecommunications and Information Administration
QAM	Quadrature amplitude modulation
QEF	quasi-error-free
RN	Reference network
RPC	Reference planning configuration
RRC	Regional Radio Conference
SFN	Single frequency network
SNR	Signal-to-noise ratio
T	Temperature degrees Kelvin
VHF	Very high frequency
VRP	Vertical radiation pattern
UE	User equipment
UHF	Ultra-high frequency