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Spectrum Management and Telecommunications

Broadcasting Procedures and Rules

Part 10: Application Procedures and Rules for Digital Television (DTV) Undertakings

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Canada

Preface

Issue 2 of BPR-10 is hereby released.

Listed below are the changes:

(a) A new option to submit applications online has been introduced.
(b) The definitions for *allotment* and *allocation* have been updated.
(c) WGS84 (World Geodetic System 1984) is defined as the new standard for geographical coordinates.
(d) A new file format has been established for antenna patterns.
(e) A new emission mask option for LPDTV is provided.
(f) Co-channel and first-adjacent interference criteria between DTV and LPDTV have been added.
(g) References to transitional DTV have been removed.
(h) Other updates have been made, including editorial changes.

Issued under the authority of the Minister of Innovation, Science and Economic Development.

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Contents

1. International Agreements

1.1 Coordination with the United States

To facilitate analog-to-digital conversions, the governments of Canada and the United States signed an Exchange of Letters in 2008 that outlines the provisions for television allotments and assignments within 360 km of the common border. The Exchange of Letters can be found on Innovation, Science and Economic Development Canada's (ISED) website.

The *DTV Post-Transition Allotment Plan* has been coordinated with the United States. Television broadcasting allotments and assignments in Canada will be subject to the terms of a future *Agreement Between the Government of the United States of America and the Government of Canada Relating to the Use of the 54-72 MHz, 76-88 MHz, 174-216 MHz, and 470-698 MHz Bands for the Digital Television Broadcasting Service Along the Common Border*.

The Agreement states the basis upon which both administrations consider responses to border-area allotments and assignments. It also:

- facilitates the development of new digital services;
- establishes criteria for the protection of broadcasting services in both countries;
- ensures efficient and equitable utilization of digital television broadcasting spectrum;
- defines technical criteria for the notification of television allotments and assignments; and
- contains lists of the Canadian and U.S. allotments within their respective coordination areas.

2. Digital Television Broadcasting – General Information

2.1 Definitions

Allocation: An allocation is an entry in the *Canadian Table of Frequency Allocations* of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term also applies to the frequency band concerned.

Allotment: An allotment is the entry of a designated frequency channel in an agreed plan, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions. The DTV allotment plans are available on ISED's website.

An up-to-date list of Canadian channels can also be found on the Department's website.

Associated Allotment: An associated allotment is one that is associated with a National Television Systems Committee (NTSC) station.

Vacant Allotment: A vacant allotment is a standalone allotment that can be claimed on a first-come, first-served basis.

Assignment: An assignment is the authorized operation of an undertaking. Associated allotments are considered assignments.

Primary Assignment: A primary assignment is a television station authorized for operation on an allotment. A primary assignment receives protection from other allotments, as well as from other primary and secondary assignments. In this document, all references to assignments refer to primary assignments unless otherwise noted.

Secondary Assignment: A secondary assignment is a low-power television (LPTV or LPDTV) station that operates on the basis of not causing interference to, nor receiving protection from, primary assignments.

Television Channels: The frequencies allocated to broadcasting are designated by a channel number. Each channel has a 6 MHz bandwidth as follows:

Band	Channels	Frequencies (MHz)
Low VHF	2 to 4 inclusive	54-72
Low VHF	5 and 6	76-88
High VHF	7 to 13 inclusive	174-216
UHF	14 to 51 inclusive*	470-698

* The frequency band 608-614 MHz, channel 37, is allocated to the Radio Astronomy Service and is therefore not available for broadcast use.

Noise-Limited Bounding Contour (NLBC): The noise-limited bounding contour corresponds to the field strength value that delimits the geographical area within which reception is predicted for 50% of locations and 90% of time using the methodology specified in Annex D. The field strength values are provided in Tables 1 and 2 below, and are determined from the DTV planning factors identified in Annex H.

Table 1: Field Strengths Defining Noise-Limited Bounding Contours for Primary Assignments

Channels	Defining field strength, dBµV/m, to be predicted for 50% of locations, 90% of time
2-6	28
7-13	36
14-51	41 – 20 log[615/(channel mid-frequency in MHz)]

Table 2: Field Strengths Defining Noise-Limited Bounding Contours for Secondary Assignments

Channels	Defining field strength, dBµV/m, to be predicted for 50% of locations, 90% of time
2-6	43
7-13	48
14-51	51 – 20 log[615/(channel mid-frequency in MHz)]

Protected Area: The protected area of an allotment or assignment is the geographic area inside the noise-limited bounding contour where the (50, 90) field strength, as predicted using the appropriate effective radiated power (ERP) and a terrain-sensitive propagation model, equals or exceeds the noise-limited field strength values specified in Table 1 above. The protected area is determined using the methodology outlined in Annex D. It is limited to a distance of 100 km for primary assignments or 20 km for secondary assignments.

DTV Urban Contour (DUC): The location of the DTV Urban Contour should be determined using the ERP, EHAAT and the propagation curves specified in Annex F for 50% of locations and 90% of time.

Table 3: Field Strengths of Digital Urban Contour

Channels	Field strength (dBµV/m)
2-6	59
7-13	60
14-51	61 – 20 log[615/(channel mid-frequency in MHz)]

Effective Radiated Power (ERP): The ERP is the product of the transmitter output power, the transmission line (and combiner) efficiency and the power gain of the antenna relative to a half-wave dipole. The maximum ERP is calculated using the maximum value of radiation from the antenna in the plane of maximum radiation (i.e. beam tilt) and in the direction of maximum radiation for directional antennas.

Effective Height Above Average Terrain (EHAAT): An antenna's EHAAT is the average of the antenna's Height Above Average Terrain (HAAT) for 8 standard radials spaced every 45 degrees of azimuth starting with true north. The HAAT is the height of the centre of radiation of the antenna above the average elevation of the terrain, based on Canadian Digital Elevation Data (CDED) or equivalent, as measured from 3 to 16 km from the antenna for an individual radial. Determination of HAAT does not stop at the border or over bodies of water. HAAT incorporates the full 3 to 16 km radial segment, and will not employ truncated radials for calculations of radial average elevations above mean sea level (AMSL). In the event of a discrepancy, the analysis by the Department shall prevail.

The EHAAT of a LPDTV station should be determined using the average elevation of the terrain measured in metres from 0 to 5 km along 4 standard radials at 0, 90, 180 and 270 degrees from true north.

Antenna Beam Tilt: An antenna electrical beam tilt involves the shaping of the radiation pattern in the vertical plane of a transmitting antenna by electrical means so that maximum radiation occurs at an angle below the horizontal plane. An antenna mechanical beam tilt involves the installation of a transmitting antenna in a way to lower the normal angle of maximum radiation in the vertical plane.

DTV Assignment and Allotment Parameters

Maximum Operating Parameters of DTV and LPDTV Assignments

Table 4a: Maximum Permissible Operating Parameters of DTV Assignments

Channel	ERP (W)	EHAAT (m)
2-6	30 000	300
7-13	60 000	300
14-51	2 000 000	300

Table 4b: Typical Maximum Operating Parameters Used for the Development of the Post-Transition Plan

Channel	ERP (W)	EHAAT (m)
2-6	2 400	300
7-13	10 600	300
14-51	850 000	300

Table 5: Maximum Permissible Operating Parameters of LPDTV Assignments

Channel	ERP (W)	EHAAT (m)
2-6	370	30
7-13	600	30
14-51	2 600	30

EHAAT and Power Equivalence: Where the EHAAT exceeds the values shown in Tables 4a and 5, the ERP shall be reduced to provide equivalence with the applicable maximum parameters. Equivalence requires that the distance to the *Noise-Limited Bounding Contour* field strength, calculated using the maximum ERP, EHAAT and the F(50, 90) field strength charts in Annex F, remain the same.

Order of Protection: Primary NTSC assignments shall not cause interference to, or claim protection from, primary DTV assignments.

Secondary NTSC assignments shall not cause interference to, or claim protection from, secondary DTV assignments.

2.2 Television/Terrestrial Mobile Protection Criteria

Criteria for the mutual protection of the services to operate in the vacated spectrum above channel 51 and TV broadcasting services are under development.

3. Applications for Primary Digital Television Broadcasting Undertakings

3.1 Application Requirements

An application to the Department for a broadcasting certificate shall be accompanied by an application to the Canadian Radio-television and Telecommunications Commission (CRTC) for a broadcasting licence, unless the application is exempted from CRTC licensing requirements. Application requirements for a broadcasting licence can be obtained from the CRTC. If confirmation of the CRTC application is not received within 30 days, the technical application will be returned to the applicant.

All necessary forms may be obtained from the Spectrum Management and Telecommunications website.

3.1.1 Online Application Requirements

When submitting an application to the Department **online**, the applicant shall use the following website: http://sms-sgs.ic.gc.ca.

The following documentation shall be attached to the application:

- An engineering brief (in PDF format) as per Section 3.2, including any required maps prepared in accordance with Section 3 of BPR-1, *General Rules*;
- Electronic contour maps (MapInfo format: *.dat/*.id/*.map/*.tab or GIS format: *.mif,*.mid) in accordance with Section 3.3 of BPR-1; and
- A text file containing horizontal and vertical antenna pattern data, in accordance with Annex E of BPR-1.

3.1.2 Email Application Requirements

When submitting an application to the Department via **email**, the applicant shall use the following email address: IC.broadcasting-radiodiffusion.IC@canada.ca.

In addition to the documentation required for an online submission, the following shall be included:

- Form ISED-ISDE3050, *Application for a Broadcasting Certificate for a Regular Power Undertaking* (in PDF format);
- Form IC-2430, *Radiocommunication and Broadcasting Antenna Systems Attestation* (in PDF format) and, as applicable, a copy of the Letter of Intent to the land-use authority as described in BPR-1, Section 2.

It is the responsibility of the applicant submitting the application to ensure that all electronic documents submitted have the necessary signatures.

The Department reserves the right to request a signed attestation to verify the authenticity of an application and may suspend the processing of the application until a satisfactory attestation has been received.

3.1.3 Written Application Requirements

When submitting a **written** application, printed and signed versions of the application form and other documentation described in sections 3.1.1 and 3.1.2 shall be provided.

3.1.4 Other Requirements

All proposed antenna structures, whether new or modified, low power or full power, must comply with the requirements of ISED's Client Procedures Circular CPC-2-0-03, *Radiocommunication and Broadcasting Antenna Systems*, and Section 2 of BPR-1.

In addition to meeting the requirements concerning site sharing, land-use consultation and public consultation, applicants must also fulfill other important obligations, including:

- compliance with Health Canada's Safety Code 6 guideline for the protection of the general public,
- compliance with radio frequency immunity criteria,
- notification of nearby broadcasting stations,
- environmental considerations and
- Transport Canada/NAV CANADA's aeronautical safety responsibilities.

3.2 Engineering Brief Requirements

The order of material in the engineering brief shall be maintained as listed below to simplify processing in the Department. The metric system known as SI (Système International) shall be used throughout the engineering brief.

3.2.1 Title Page

The title page shall include the submission title, type of undertaking proposed, name and address of the applicant, name of the broadcasting consultant, as well as the location of the proposed broadcasting undertaking and submission date. The project or reference number shall also be included.

3.2.2 Table of Contents

The table of contents shall cross-reference pages and sections of the brief.

3.2.3 Summary Sheet

The summary sheet shall be prepared as per Annex A. The summary sheet is optional for online applications.

3.2.4 Main Section of Brief

3.2.4.1 Introduction

There should be a general statement of the purpose of the brief in relation to the application, including the primary centre(s) to be served within the digital urban contour and the noise-limited bounding contour.

3.2.4.2 Discussion

There should be a discussion on the design considerations necessary to accomplish the applicant's objectives, including the site location, choice of channel and operating parameters (the consultant should be guided by the requirements set forth in this Section).

3.2.4.3 Assumptions and Sources of Information

List and explain all assumptions and sources of information used in compiling the engineering brief.

3.2.4.4 Interference Analysis

If necessary, include an interference analysis in support of the transmitting channel(s) and the selected parameters (refer to Section 3.6).

3.2.4.5 Transmitter

Specify the make, type and output power (rated and operating) of the transmitter. Emissions shall meet the applicable emission masks shown in Figure C1 of Annex C.

In some circumstances, the Department may require the use of an emission mask with more stringent characteristics (out-of-band emissions) to protect adjacent band services.

3.2.4.6 Description of Antenna System

The following details are required:

- Antenna: Manufacturer, type, model number, number of sections (if applicable), power gain and vertical radiation pattern. For directional antennas, the horizontal pattern is required (refer to Section 3.2.6). The largest dimension of the antenna shall be provided;
- Transmission Line: Manufacturer, type, length in metres and efficiency;
- Combiner: Manufacturer and operational characteristics;
- Polarization: Horizontal, circular or elliptical polarization as proposed. Horizontal polarization is normally used.

3.2.4.7 Bounding Contour Table

Tabulated bounding contour predictions shall be provided according to the guidelines in Annex D.

3.2.4.8 Special Analysis and Commitments Relative to Interference to Other Broadcasting Undertakings

Analyses shall be submitted — with appropriate commitments made — in regard to all potential interference situations with other broadcasting undertakings as a result of the operation of the proposed television facility.

The following are some examples of interference possibilities with other broadcasting services that shall be explored:

(a) Distortion of AM radiation patterns by the new television tower located in the vicinity of an AM antenna array;

(b) Isolation of AM, FM and television transmissions, where such services are co-located;

(c) Interference to FM channels 201 to 220 from channel 6:

- For co-located channel 6 and FM stations, protection of the FM can be achieved when the TV/FM power ratio is below 30 dB for all FM channels except FM channel 201, for which the required ratio is 9 dB.
- For television stations located outside the protected FM service area (0.5 mV/m contour), interference-free FM operations will be provided with 20 km (62 km for FM channel 201) separation between the television transmitter and the FM protected contour.
- If the proposed TV assignment is located within the protected FM service area then a D/U analysis using the above ratios should be submitted.

(d) Interference to LPTV and LPDTV assignments: Although these are unprotected assignments, they should be notified of potential interference to their service. Such notification shall be made in writing to the affected broadcaster, with a copy forwarded to the Department (refer to Section 3.6.6).

3.2.4.9 RF Exposure and Strong Adjacent Channel Interference Issues

The applicant shall submit analyses regarding these issues. Refer to Sections 3.1.4 and 3.7 for the requirements.

3.2.4.10 Off-Air Reception and Microwave Links

When a television rebroadcasting station receives a feed from an existing facility using off-air reception (or a combination of off-air reception and microwave links), the engineering brief should specify the type of feed and give a description of the system.

3.2.5 Antenna Location and Diagrams

The location of all structures and antenna sites that are of relevance to the site-specific analyses undertaken for the purpose of the application shall be provided in the engineering brief. The latitude-longitude geographical projection and the datum WGS84 shall be used.

An elevation diagram of structure and transmitting antenna and a description of the major components of the system, including a block diagram, shall be provided (refer to Annex B). For rooftop installations, include an elevation diagram of the building, including the height of the rooftop.

3.2.6 Radiation Patterns

3.2.6.1 Vertical Radiation Pattern

The vertical radiation pattern of the antenna (relative field versus degrees) must be plotted in rectangular coordinates from 90° above (positive values) to 90° below (negative values) the horizontal plane.

3.2.6.2 Horizontal Radiation Pattern

A polar plot of the horizontal pattern is required when directional antennas are employed. True north and the r.m.s. field shall be clearly indicated on this plot. The ratio of maximum to minimum fields of directional antenna systems shall not be greater than 20 dB except where signal reflections due to local terrain will present a reception problem or where other circumstances exist, such as a large body of water. When a directional pattern is proposed, the brief should contain a letter from the manufacturer stating that the proposed pattern can be achieved.

Note: Title blocks shall be placed on radiation patterns for directional antenna systems since, in some instances, for areas along the Canada-U.S. border, it may be necessary to submit this material separately when notifying the new assignments to the U.S. Federal Communications Commission (FCC). The title block shall include the identification of the undertaking, frequency, maximum ERP and date.

3.2.6.3 Pattern Data Tables

Vertical and horizontal pattern data (if applicable) must also be provided in tabular format in relative field (%).

Vertical pattern data shall include a maximum of 181 points. These points shall be distributed appropriately to reflect the shape of the actual pattern from the manufacturer as closely as possible, especially along each peak and null covering the full range from -90 to +90 degrees.

Horizontal pattern data must be provided at 1-degree intervals starting from true north.

For electronic applications, a text file containing the pattern data is required in the format defined in Annex E of BPR-1.

3.2.7 Maps

Provide a map (scale 1:50 000) showing the proposed antenna site location and its geographical latitude and longitude coordinates (refer to Section 3 of BPR-1).

Provide a map showing the noise-limited bounding contour and the digital urban contour. For further details concerning the preparation of maps for engineering briefs, refer to Section 3 of BPR-1.

Maps may be provided indicating the protected areas and interference for the proposed assignment and any other affected assignments or allotments (refer to Section 3.6.2).

When a change to the facility is proposed, the applicant shall provide maps indicating comparative contours.

For applications using associated allotments, the applicant shall provide a map showing the noise-limited bounding contour, the digital urban contour of the proposal and the Grade A and B contours of the corresponding analog undertaking (a CRTC requirement).

The latitude-longitude geographical projection and the datum WGS84 (up to 2 decimals for the seconds) shall be used.

3.3 Technical Operation of Broadcast Transmitter Plants

A description of the technical equipment in compliance with the minimum requirements specified in Section 5.1 of BPR-1 shall be submitted prior to on-air tests for the approved facility. If unattended operation is proposed, a statement that the unattended operation meets the minimum requirements of Section 5.1 of BPR-1 is required.

3.4 Application Requirements for Non-Program-Related Data

Television undertakings planning to transmit non program-related data using the excess capacity of the digital channel shall submit a description of the data to ISED. Such applications are authorized under the *Radiocommunication Act* and the *Radiocommunication Regulations*, and are subject to the applicable authorization fee and to any requirements under the *Telecommunications Act*. If the data service is intended for the reception of the general public, CRTC approval may be required.

The holder of a broadcasting certificate for a television undertaking is not required to notify the Department of the addition of broadcasting program services using the excess capacity of the digital channel (such as multiplexing); however such services may require CRTC approval.

3.5 On-air Testing Procedure

The procedure as outlined in Section 1.4 of BPR-1 shall be followed.

3.6 Interference Analyses and Notifications

An allotment or assignment should be designed to minimize interference to nearby allotments or assignments, but there are situations where interference may occur as a result of the choice of parameters and location. Annex E describes the criteria for determining which nearby digital television assignments or allotments may cause interference to, or receive interference from, the proposed assignment or allotment. Annex G describes the criteria for determining which nearby NTSC assignments may cause interference to, or receive interference from, the proposed assignment or allotment.

To avoid mutual interference, the transmitting sites of stations on the first-adjacent channel should be co-located, near (within 1 km) or outside the noise-limited bounding contour of the station on the first-adjacent channel.

It is the responsibility of the applicant to assess interference to the proposed assignment’s protected area.

3.6.1 Criteria to Determine When Analyses are Required

Analyses related to primary assignments and allotments as per Annex E or Annex G will only be required in certain situations.

Short-spacing analyses will be required regarding secondary assignments, as per Section E2 of Annex E or Section G2.4 of Annex G, to identify all affected secondary assignments and inform them about the potential impact, using the notification procedure outlined in Section 3.6.6.

DTV assignments are not required to protect the remaining NTSC assignments. However, DTV proposals need to identify all short-spaced NTSC assignments and inform them about the potential impact, using the notification procedure outlined in Section 3.6.6.

3.6.1.1 Proposals Using Associated Allotments in the DTV Post-Transition Allotment Plan

Analyses related to primary television services are not required for a DTV application using an associated allotment in the *DTV Post-Transition Allotment Plan* that complies with the following:

- channel as listed in the plan;
- noise-limited bounding contour not exceeding the contour as calculated using the reference parameters listed in the plan.

Additionally, if the proposal is not co-located, near co-located (within 1 km) or located outside the noise-limited bounding contour of a DTV assignment on the first-adjacent channel, analyses related to that assignment will be required.

3.6.1.2 Other Applications

An application to operate facilities based on a vacant allotment in the *DTV Post-Transition Allotment Plan*, or on a drop-in channel, requires analyses related to DTV assignments and allotments.

3.6.2 Interference Analysis Requirements

Calculations shall be provided to demonstrate that any population service loss from the proposal to affected assignments and allotments meets the interference ceilings in Section 3.6.3. The percentage of population service loss shall be provided for each affected allotment and assignment.

Maps illustrating the extent of any interference shall be provided and additional calculation details shall be made available upon request.

A full interference analysis using the Longley-Rice propagation model, version 1.2.2, must be provided for a proposed allotment or assignment that requires Canada-U.S. coordination.

3.6.3 Interference Ceilings

Depending on the proposal, the following interference ceiling conditions apply:

- A proposal for a new assignment or a new associated allotment or for converting a vacant allotment to an associated allotment shall not cause greater than 0.5% population service loss to a previously planned or approved assignment or associated allotment in the *DTV Post-Transition Allotment Plan*.

- A proposal for a modified assignment or an associated allotment under an existing plan allotment is allowed to cause up to 0.5% population service loss to an existing primary assignment or to an associated allotment in the *DTV Post-Transition Allotment Plan*. If the 0.5% limit is already exceeded by the proposal's corresponding allotment reference facilities in the plan or by the proposal's existing assignment, no additional population service loss will be allowed.

- A proposal for a new or modified assignment or allotment shall not cause greater than 5% additional population service loss to a previously planned or approved vacant allotment. However, no additional population service loss is allowed if the cumulative population service loss to the planned or approved vacant allotment is greater than or equal to 20%.

- A proposal for a new or modified vacant allotment shall not cause any additional population service loss to a planned or approved assignment or associated allotment.

- Population service loss shall be calculated as described in Section E7 of Annex E and Section G2.5 of Annex G.

3.6.4 Modifications to the DTV Allotment Plan

When an application for a new television undertaking requires modifications to existing assignments or allotments in the *DTV Post-Transition Allotment Plan*, the applicant may consult with the Department regarding these modifications prior to the formal filing of the application.

Studies in support of the proposed modifications shall show that the coverage objective of the proposal cannot be achieved by less drastic measures.

The following types of proposed modifications are possible, either separately or in combination:

(a) **Changing the channel of an allotment or assignment –** In the case of assignments or associated allotments, the licensee's or the assignee's agreement, as appropriate, shall be obtained (refer to Section 3.6.5);

(b) **Modifying the technical parameters or limiting an allotment or assignment –** In the case of assignments or associated allotments, the licensee's agreement shall be obtained (refer to Section 3.6.5);

(c) **Moving an allotment to another area and replacing the shifted allotment with a suitable channel**;

(d) **Deleting an allotment**; and

(e) **Converting a vacant allotment to an associated allotment –** These proposals shall be accompanied by a technical submission with an appropriate interference analysis.

A proposal to change the channel or the technical parameters of an allotment in the Post-Transition Allotment Plan, shall be supported by a technical submission demonstrating that the change would provide improved channel utilization. The proposed change shall conform to the interference ceilings contained in Section 3.6.3. Interference calculations for DTV should be performed following the methodology in Annex E. Interference calculations for NTSC should be performed following the methodology in Annex G.

It is noted that some of the types of proposed modifications mentioned above may have a positive impact in one area, but a negative impact in another area. If the Department accepts the changes, it will report to the CRTC on the technical aspects of the changes and their impact, provided that the proposal is based on a complete application. These changes will be considered technically acceptable pending a decision by the CRTC. Any changes to the plan that may be required as the result of such applications will not be made until the Department declares them technically acceptable and the CRTC approves the application.

3.6.5 Notification of Primary Assignments

The applicant shall send a copy of the engineering brief with a covering letter to the broadcasting certificate holder of all short-spaced primary assignments and associated allotments as identified in Section 3.6.1, preferably on the date of filing the application or immediately after the CRTC has issued a Notice of Public Hearing.[1]

A copy of this letter and confirmation of receipt by the affected broadcasting certificate holder, as proof of delivery, shall be sent to ISED. The letter shall advise the certificate holder of the situation and of interference or proposed changes where applicable, and shall emphasize that any representations that the certificate holder may wish to make to the Department shall be submitted to the Department with a copy to the applicant, no later than 30 days after receipt of the engineering brief.

If the affected certificate holder offers an objection, ISED may reject and return the application. The Department reserves the right to make an independent decision concerning the disposition of the application. If no reply is received within the specified period, it will be assumed that there is no objection.

The affected certificate holder shall use the criteria contained herein, together with established engineering practices, to assess the impact of the proposal. The Department will review the certificate holder's response from a technical point of view and will reserve the right to make an independent decision concerning the disposition of the application.

[1]The applicant should send the letter and the copy of the brief early enough so that the affected licensee can reply, at the latest, 20 days before the start of the public hearing. Should the 30-day response time fall beyond this deadline, the Department will not send technical comments to the CRTC. It should be noted that, in this case, the applicant is taking the risk of having the application withdrawn and assumes the responsibility for it.

Applicants proposing to modify the technical parameters or change the channel of an assignment that results in additional capital and operating cost for existing assignments will be expected to cover these expenses.

3.6.6 Other Notifications

The applicant shall send a copy of the engineering brief with a covering letter to the broadcasting certificate holder of all short-spaced LPTV and LPDTV assignments as identified using the methodologies of Annexes E and G, preferably on the date of filing the application or immediately after the CRTC has issued a Notice of Public Hearing.

The applicant shall send a copy of the engineering brief with a covering letter to the broadcasting certificate holder of all short-spaced NTSC assignments as identified using the methodologies of Annex G, preferably on the date of filing the application or immediately after the CRTC has issued a Notice of Public Hearing.

A copy of this letter and confirmation of receipt by the affected broadcasting certificate holder, as proof of delivery, shall be sent to the Department. The letter shall advise the certificate holder of the situation, the possibility of interference and the need for remedial action should the application become operational.

3.6.7 Incompatibilities

In all of the cases described in Section 3.6.1, problems can arise when changes to the plan proposed by one applicant are not compatible with changes proposed by another applicant. It should be noted that incompatibilities can occur even when the proposed services are geographically well separated.

The Department encourages applicants to cooperate in the search for an early solution to problems of incompatibility. In this regard, the Department will, without divulging the details of the proposed changes, make any incompatibility known to each of the applicants involved, urging resolution prior to consideration of the applications by the CRTC.

3.6.8 Allotment Planning

ISED may make changes to the DTV Allotment Plan independent of any application received. In its role as spectrum manager, it will also make independent decisions based on technical considerations.

3.7 Assessment and Control of Maximum Field Strength of TV Broadcasting Assignments

3.7.1 Introduction

Service requirements and constraints related to the siting of television broadcasting assignments may result in high signal strength levels in populated areas. Under these conditions, TV receivers may be susceptible to interference from strong adjacent TV signals. Broadcast receivers are also susceptible to immunity-type interference. Non-radio frequency equipment (radio-sensitive equipment) may also be affected by TV emissions. To avoid or minimize such problems, applicants are encouraged to locate their transmitters away from populated areas. Where this is unavoidable, it is necessary to assess the potential for interference.

3.7.2 Purpose

The purpose of this Section is to:

- identify the analysis required from applicants in determining interference potential;
- define the responsibilities of broadcasters in response to interference complaints; and
- identify non-valid complaints of interference.

The requirements of this Section apply to all applications for the issue or amendment of broadcasting certificates for television broadcasting assignments.

3.7.3 Requirements Regarding Interference Analysis and Population Estimates

In addition to the requirements in Section 3.2 pertaining to the engineering brief, interference analyses are required, as discussed in this Section. In specific cases, the Department may accept a common assessment for co-located assignments, multiplexed or otherwise.

Strong adjacent TV signal interference can take place in the vicinity of a television assignment and the severity of the interference potential depends on the broadcasting radio environment. The proposed station's 120 dBµV/m contour (channels 2-6 inclusive) or the 115 dBµV/m contour (channels 7-69 inclusive) is to be plotted on an appropriately-scaled map and submitted to the Department. An estimate of the population within this contour shall also be provided. The calculations should be based on the methodology in Section 3.7.5, for high field strengths.

Every attempt shall be made to keep the population within the above area to a minimum. The Department reserves the right to request changes to the antenna site, to the antenna height, to the antenna itself, or to the radiated power to reduce the population within this high field strength area.

3.7.4 Immunity-Type Interference

Broadcast receivers and their associated equipment, as well as non-radio equipment (radio-sensitive devices), are expected to operate properly within field strengths lower than those indicated in ISED's *Electromagnetic Compatibility Advisory Bulletin 2* (EMCAB-2). The Department uses EMCAB-2 to make determinations on interference or immunity cases.

3.7.5 Method for Calculating High Field Strength Contours

The vertical and horizontal antenna radiation patterns (if the antenna is directional) are normally supplied by the antenna manufacturer. In predicting high field strength contours, the ERP should be based on the appropriate antenna vertical plane radiation pattern for the pertinent azimuthal direction.

For distances less than 1.5 km from the transmitting site, the field strength should be determined from the following free-space formula;

$$F = 137 + 10log(ERP) - 20log(d)$$

where:

F: is the field strength in dBμV/m (dB above one microvolt per metre);

ERP: is the effective radiated power in watts at the pertinent depression angle; and

d: is the slant distance (in metres) between the centre of radiation of the antenna and the receiving location.

For distances between 1.5 and 4 km, the field strength should be determined from the F(50,90) curves using the height of the antenna radiation centre with respect to the receiving location under consideration.

For distances beyond 4 km, the field strength should be determined from the F(50,90) curves using the pertinent HAAT.

The antenna height and the distance from the tower should be used to determine the depression angle. The ERP for that direction shall be determined by the depression angle and the vertical pattern information of the antenna. For the horizontal directional pattern, the power shall also be adjusted according to the azimuth selected.

Close-in field strength prediction may involve nulls in the vertical radiation pattern which shall be taken into consideration. The distances (d_i) along the ground, where the field strength is minimal due to a vertical pattern null, can be calculated by the following relationship:

$$d_i = \frac{H}{\tan(\theta_i + A)}$$

where:

A and θ_i are the beam tilt angle and the angles corresponding to the different nulls in the vertical pattern respectively (both in degrees);

H = height (in metres) to radiation centre of antenna; and

d_i = distances in metres along the ground.

For values of $\theta_i + A \leq 10°$:

$$d_i = 57.3 \frac{H}{\theta_i + A}$$

3.7.6 Resolving Issues

The broadcaster will accept responsibility as follows.

(a) In the case of strong adjacent channel (2nd, 3rd and 4th) interference relative to an assignment:

- address complaints of interference within the 120 dBµV/m contour (channels 2-6 inclusive) or the 115 dBµV/m contour (channels 7-69 inclusive) of the interfering DTV assignment on an adjacent channel (refer to Section 3.7.7 for a list of complaints judged not valid by the Department);
- keep the appropriate district office of the Department fully informed of all complaints received and action taken.

(b) In the case of immunity-type interference:

- The broadcasters will be responsible for solving immunity-type interference for valid complaints.
- The guidelines on resolving immunity issues relating to radio-sensitive equipment are outlined in Client Procedures Circular CPC-3-14-01, *Determinations of Harmful Interference with Respect to Radio-Sensitive Equipment*. CPC-3-14-01 can also be used as a guide for resolving immunity-related interference to broadcast receivers and associated equipment.

3.7.7 Complaints Judged Not Valid by ISED

The following is the list of complaints judged not valid by the Department and for which the broadcaster is not responsible for remedial action:

(a) where the complaint is attributed to the use of a malfunctioning or mistuned receiver or an improperly installed or defective antenna system;

(b) where the complaint is attributed to the desired signal being received outside the area where service is normally expected;

(c) where the complaint is attributed to the desired signal not being favourably received because of adverse local propagation conditions or building penetration losses;

(d) where the complaint involves the reception of signals originating from outside of Canada;

(e) where the complaint involves a high gain receiving antenna and/or an antenna booster amplifier intended for reception of distant assignments which, as a consequence, overloads the receiver or creates intermodulation in the amplifier output;

(f) where the complaint is attributed to the reception of a TV assignment which, under normal allotment criteria, is not fully protected from interference, or where the complaint originates from a planned interference zone;

(g) where the complaint is attributed to immunity-type interference to broadcast receivers and associated equipment located in an area where the measured field strength does not exceed the 125 dBµV/m;

(h) where the complaint is attributed to immunity-type interference to radio-sensitive equipment that is located in an area where the measured field strength does not exceed the 130 dBµV/m;

(i) any other complaint which, in the judgment of the Department, is considered not valid.

3.8 Transport Stream Identifier (TSID)

TSID is an integral part of the ATSC PSIP Standard A/65. The TSID identifies an individual broadcast assignment and facilitates the tuning of DTV receivers.

TSIDs for use in Canada are assigned by the Department. An up-to-date list of TSIDs is available as part of the broadcasting database. Applicants can refer to that list to find their assigned TSID prior to starting regular broadcast emissions.

4. Applications for Low-Power Digital Television (LPDTV) Broadcasting Undertakings

4.1 Preamble

LPDTV assignments are considered secondary assignments. In other words, assignments are established on an unprotected basis.

If an assignment established in accordance with this Section causes unacceptable interference to primary television assignments, whether established before or after the LPDTV assignment, remedial measures must be taken, even to the extent of closing down if another suitable channel cannot be used.

An LPDTV assignment is not entitled to protection from interference from primary television assignments. An LPDTV assignment is entitled to protection from other LPDTV assignments that are established at a later date.

Where a new primary television assignment, or one that has changed parameters, causes interference to an LPDTV assignment but does not receive any, the latter may either accept the interference or make application to change its operation to alleviate the interference.

4.2 Required Documents

All necessary forms may be obtained from the Spectrum Management and Telecommunications website.

4.2.1 Online Application Requirements

To submit an application to ISED **online**, use the following website: http://sms-sgs.ic.gc.ca.

The following documentation shall be attached to the application:

- a separate engineering brief may be required in accordance with Section 4.3;
- a contour map in accordance with Section 4.3.6; and
- a text file containing horizontal and vertical antenna pattern data, in accordance with Annex E of BPR-1.

4.2.2 Email Application Requirements

To **email** an application to the Department, use the following email address: IC.broadcasting-radiodiffusion.IC@canada.ca.

In addition to the documentation required for online submissions, include the following documentation:

- Form ISED-ISDE3051, *Application for a Broadcasting Certificate for a Low-Power or Very Low-Power Undertaking* (in PDF format);
- Form IC-2430, *Radiocommunication and Broadcasting Antenna Systems Attestation* (in PDF format) and, as applicable, a copy of the Letter of Intent to the land-use authority as described in BPR-1, Section 2.

4.2.3 Written Application Requirements

When submitting a **written** application, printed and signed versions of the application form and other documentations described in 4.2.1 and 4.2.2 shall be provided.

It is the applicant's responsibility to ensure that all electronic documents submitted have the necessary signatures.

The Department reserves the right to request a signed attestation to verify the authenticity of an application and may suspend the processing of the application until a satisfactory attestation has been received.

All proposed antenna structures, whether new or modified, low or full power, must comply with the requirements of Client Procedures Circular CPC-2-0-03, *Radiocommunication and Broadcasting Antenna Systems*, and Section 2 of BPR-1. In addition to meeting the requirements on site sharing, land-use consultation and public consultation, applicants must also fulfill other important obligations, including compliance with Health Canada's Safety Code 6 guideline for the protection of the general public, compliance with radio frequency immunity criteria, notification of nearby broadcasting assignments, environmental considerations and Transport Canada/NAV CANADA's aeronautical safety responsibilities.

4.3 Engineering Brief

The order of material in the engineering brief shall be maintained as listed below to simplify processing in the Department. The metric system known as SI (Système International) shall be used throughout the engineering brief.

4.3.1 Summary Sheet

This will show the submission title, type of undertaking proposed, name and address of the applicant, transmitting channel, name of the technical representative, location of the proposed broadcasting undertaking, submission date and, if applicable, the project or reference number.

4.3.2 Introduction

There should be a general statement of the purpose of the brief in relation to the application, including the primary centre(s) to be served within the noise-limited bounding contour. The programming source(s), method of programming feed and network affiliation should be indicated.

4.3.3 Transmitting Channel

A brief interference analysis in support of the selected transmitting channel should be included in the brief, with particular reference to existing television assignments and allotments in the applicable DTV Allotment Plan. This analysis should demonstrate that interference ceilings for LPDTVs, as described in Section 4.3.9, to authorized primary or low-power assignments operating in the area would not be exceeded. Technical criteria for determining interference to and from LPDTVs can be found in Annexes E and G.

4.3.4 Description of Antenna System

A description of the major components of the system, including a block diagram, should be provided. Details on the following equipment, if used, should be described:

- Antenna: Manufacturer, type, model, gain, orientation, largest dimension and radiation patterns.
- Transmission Line: Manufacturer, type, length in metres and efficiency.

4.3.5 Transmitter

Specify the make, type and output power of the transmitter (rated and operating). The output power of the transmitting equipment shall not exceed 50 watts on VHF and 500 watts on UHF band channels.

Low-power television applicants may choose to use the simple or stringent mask for LPDTVs shown in figures C2 and C3 respectively of Annex C. The applicant shall specify the type of emission mask to be employed and provide a statement related to compliance with the selected mask.

In some circumstances, the Department may require the use of an emission mask with more stringent characteristics (out-of-band emissions) to protect adjacent band services.

4.3.6 LPDTV Service

The service of an LPDTV undertaking shall not normally extend beyond a distance of 20 km in any direction from the antenna site.

In mountainous terrain locations, where the transmitting antenna height is more than 300 metres above the elevation of the community to be served, it may not be possible for the service of an LPDTV assignment to

extend less than 20 km. In such cases, a broadcast consultant shall be retained to demonstrate that existing primary and secondary assignments will be protected from interference using an analysis that follows the procedures in Annexes E and G.

The bounding contour table (see Annex D) and a suitably detailed map with the transmitting site marked and the labelled bounding contour shall be provided.

4.3.7 Radio Frequency (RF) Exposure and Strong Adjacent Signal Interference Issues

The applicant shall provide analyses related to these issues. Refer to Sections 3.1.1 and 3.7 for the requirements.

4.3.8 Off-Air Reception and Microwave Links

When a television rebroadcasting station receives a feed from an existing facility using off-air reception (or a combination of off-air reception and microwave links), the engineering brief should specify the type of feed and give a description of the system.

4.3.9 LPDTV Interference Ceilings

A proposal for a new or modified LPDTV assignment shall not cause greater than 0.5% additional population service loss to a previously approved primary or secondary assignment.

LPDTV assignments are not required to protect LPTV assignments. However, LPDTV proposals need to identify all affected LPTV assignments and inform them about the potential impact.

Annex A — Digital Television (DTV) Summary Sheet

Applicant: _____

Account number: _____

Address: _____
_____
_____

Principal Service Location: _____
(including province)
Call Sign: _____

Originating station: _____
(if rebroadcasting)
Channel: _____
TSID: _____

Site Details:
Street address or site name: _____
City: _____
Province or Territory: _____

Site Coordinates: ___° ___' ___" **N. Lat.**
(WGS84)
___° ___' ___" **W. Long.**

Transmitter:
Manufacturer / Model: _____
Output Power: _____ **kW**
Supports ATSC-MH: _____
Emission Mask: _____

Transmission Line:
Manufacturer / Type: _____
Length (m): _____
Line Loss (dB/100m): _____
Line Efficiency: _____ **%**

Other losses: _____ **%**

Antenna:

Manufacturer / Model: _____
Polarization: _____
Directional / Non-directional: _____
Number of bays: _____
Largest Dimension: _____ **Metres**
Beam Tilt: _____ °

Power Gain: _____ **Maximum** (Horizontal / Vertical / Circular Polarization)
(w.r.t. Half-Wave Dipole)
_____ **Average** (Horizontal / Vertical / Circular Polarization)

ERP: _____ **Watts Maximum**
(at beam tilt, if applicable) (Horizontal / Vertical / Circular Polarization)
_____ **Watts Average**
(Horizontal / Vertical / Circular Polarization)

EHAAT: _____ **Metres**

OHAGL: _____ **Metres** *(Overall Height of Tower Structure Above Ground Level)*

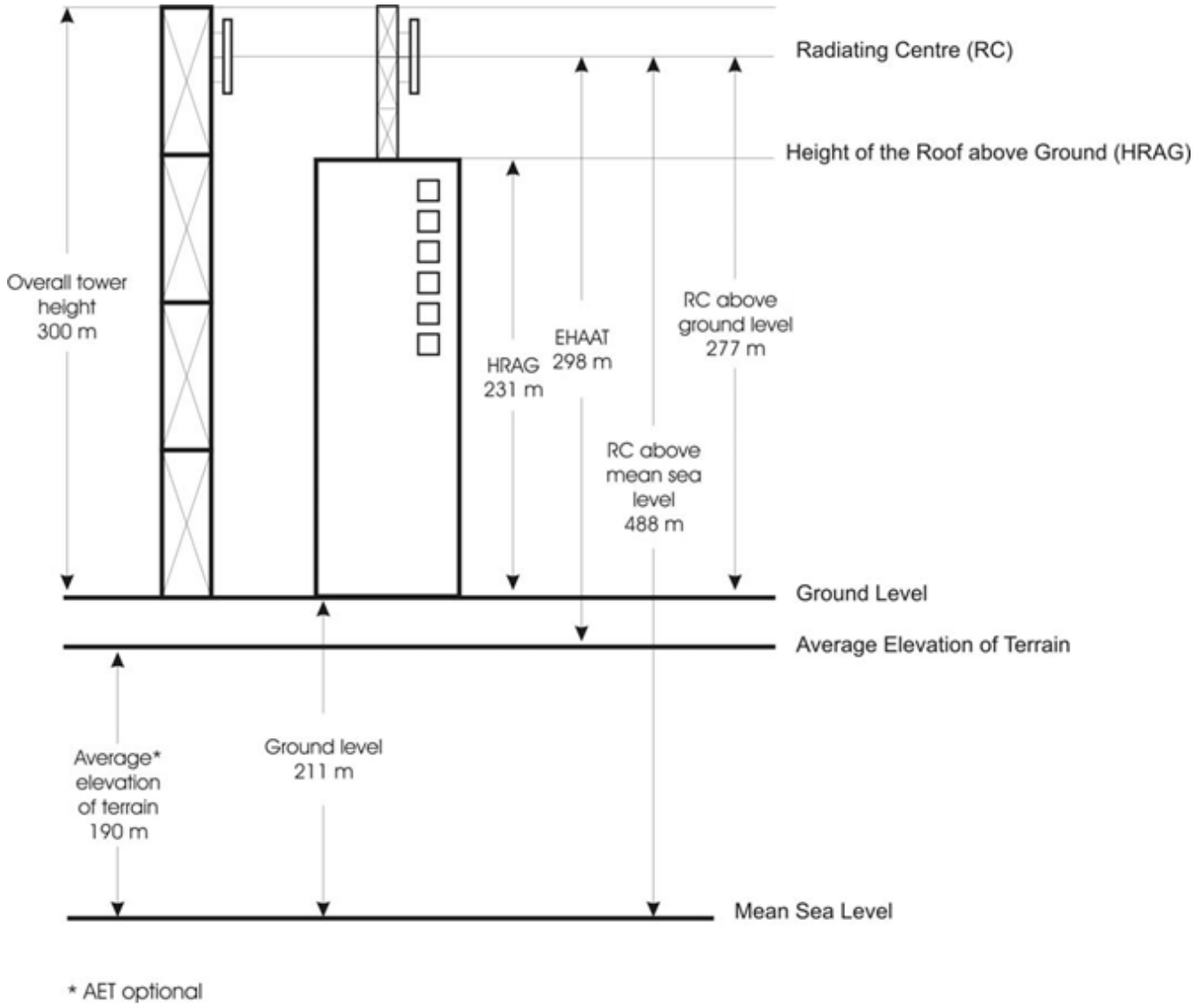
RCAGL: _____ **Metres** *(Radiating Centre Above Ground Level)*

Ground Level: _____ **Metres** *(Above Mean Sea Level)*

( ) Unattended ( ) Ancillary Service

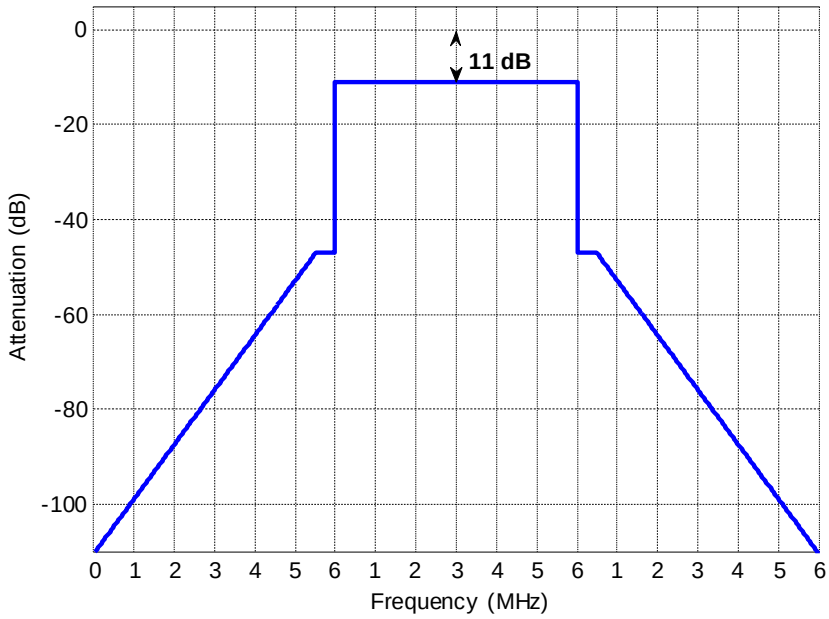
Annex B - Elevation Diagram of Typical Tower and Transmitting Antenna

Figure B1



Annex C - Emission Masks

Figure C1: DTV Emissions Mask for Primary Assignments and LPDTV Full Emission Mask (based on a measurement bandwidth of 500 kHz)



When using the DTV emissions mask for primary assignments:

1. in the first 500 kHz from the authorized channel edge, transmitter emissions must be attenuated not less than 47 dB below the average transmitted power;

2. more than 6 MHz from the channel edge, emissions must be attenuated by no less than 110 dB below the average transmitted power; and

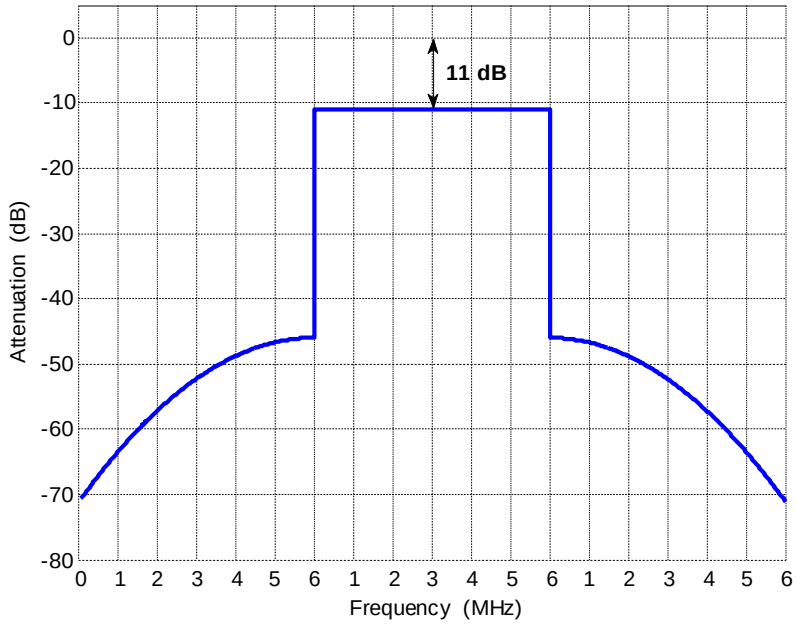
3. at any frequency between 0.5 and 6 MHz from the channel edge, emissions must be attenuated by no less than the value determined by the following formula:

   Attenuation (dB) = –11.5(delta (f) + 3.6)

   where:

   delta (f) is the frequency difference in MHz from the edge of the channel.

Figure C2: LPDTV Simple Emissions Mask (based on a measurement bandwidth of 500 kHz)



When using the LPDTV simple emissions mask:

1. in the first 500 kHz from the authorized channel edge, transmitter emissions must be attenuated not less than 46 dB below the average transmitted power;

2. more than 6 MHz from the channel edge, emissions must be attenuated by no less than 71 dB below the average transmitted power; and

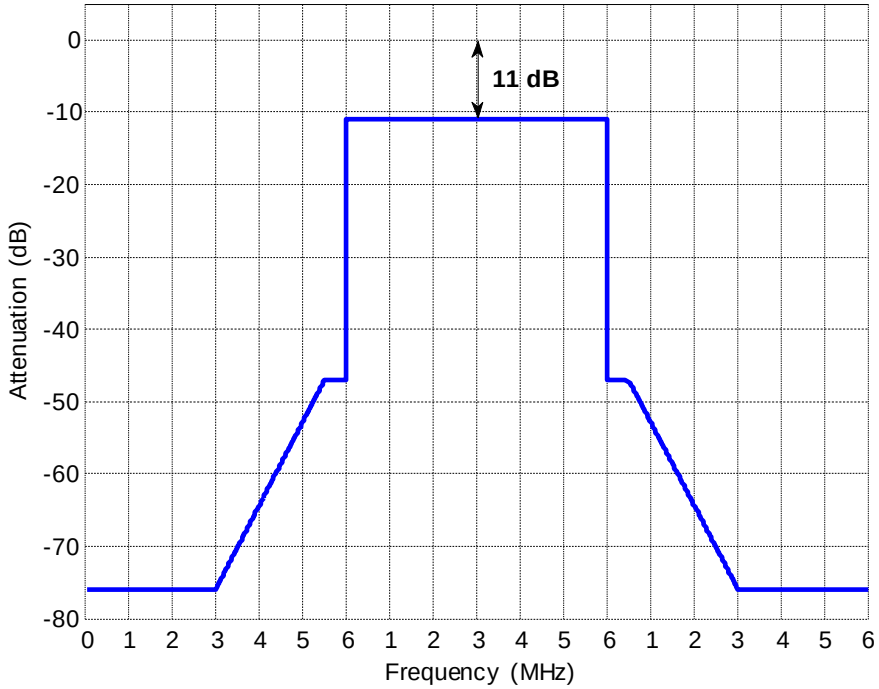
3. at any frequency between 0 and 6 MHz from the channel edges, emissions must be attenuated by no less than the value determined by the following formula:

$$\text{Attenuation (dB)} = 46 + ([\text{delta (f)}]^2/1.44)$$

where:

delta (f) is the frequency difference in MHz from the edge of the channel.

Figure C3: LPDTV Stringent Emissions Mask
(based on a measurement bandwidth of 500 kHz)



When using the LPDTV stringent emissions mask:

1. in the first 500 kHz from the authorized channel edge, transmitter emissions must be attenuated no less than 47 dB below the average transmitted power;

2. more than 3 MHz from the channel edge, emissions must be attenuated by no less than 76 dB below the average transmitted power; and

3. and at any frequency between 0.5 and 3 MHz from the channel edges, emissions must be attenuated by no less than the value determined by the following formula:

$$\text{Attenuation (dB)} = 47 + 11.5(\text{delta (f)} - 0.5)$$

where:

delta (f) is the frequency difference in MHz from the edge of the channel.

Annex D - Determination of Protected Area

D1. Introduction

Assessment of the protected area using a terrain-sensitive model is performed only within the noise-limited bounding contour.

D2. Determination of Noise-Limited Bounding Contour

The noise-limited bounding contour is computed using the site location, maximum ERP, Heights Above Average Terrain (HAATs) and the horizontal antenna radiation pattern. The distance to the bounding contour is determined, in each of the 360 degree compass directions, by using a combination of actual and linear interpolated HAAT and antenna radiation data. HAAT is determined directly from the terrain elevation database every 10 degrees, starting from true north, and by linear interpolation for radials in between. Directional antenna tabulations provide actual relative field every 10 degrees starting from true north. Linear interpolation is used to derive relative field values in between. Individual relative field values are squared and multiplied by the maximum ERP to find the ERP along a specific azimuth. In predicting the distance to the bounding contours, the F(50,90) statistics should be used to calculate the field strengths (refer to Annex F).

D3. Determination of Protected Area

The location of the noise-limited bounding contour is based on propagation curves in Annex F. The true television service availability may vary from these estimates because the terrain over any specific path is expected to be different from the type of terrain on which the propagation curves are based. Therefore, a terrain-sensitive method, with the appropriate time and location statistics, are to be used to determine the protected area.

D4. Bounding Contour Tables

The bounding contour tables for DTV should contain information as illustrated in the following example:

Table D1: DTV Contour Table

Radial No.	Azimuth (degrees)	ERP (kW)	HAAT (m)	Distance to Digital Urban Contour (km) @ 61 dBµV/m	Distance to Noise-limited Bounding Contour (km) @ 41 dBµV/m
1	0	20	190	38	62
2	45	19	207	39	63
3	90	18	232	40	64
4	135	17	335	44	71
5	180	17	281	42	67
6	225	20	200	39	62
7	270	17	311	43	69
8	315	17	296	43	68

Table D1 should be based on eight radials taken at 45 degree intervals from true north to determine the HAATs.

The bounding contour table for LPDTV should contain information as illustrated in the following example:

Table D2: LPDTV Contour Table

Radial No.	Azimuth (degree)	ERP (W)	HAAT (m)	Distance to Noise-limited Bounding Contour (km) @ 51 dBµV/m
1	0	500	28	14
2	90	2000	30	19
3	180	1000	25	17
4	270	800	27	16

Table D2 should be based on four radials taken at 90 degree intervals from true north to determine the HAATs.

Annex E - Interference Analysis

E1. Identification of Potentially Interfering Assignments and Allotments

Assignments and allotments that may be a source of interference are identified as a function of distance and channel relationships. Only those assignments or allotments whose distance from the protected station is less than the value given in Table E1 are considered as potential sources of interference.

Table E1: Culling of Undesired Assignments or Allotments

Interfering Channel Offset Relative to Desired Channel	Maximum Distance from Protected Station to Interfering Station (km)
–1	200
0	450
+1	200

E2. Short-Spacing Determination

Depending on the relative strength of the two stations involved, separation distances are based on the protection of the contour on the near side or on the far side. The required distance between adjacent channels is based on the near side value, whereas the required distance between co-channels may be based either on the near side or on the far side, whichever gives the largest distance. Both cases are calculated at the edge of a circle with radius $dist_P$. The value of $dist_P$ is computed using the propagation statistics F(50,90) given in Annex F, the Desired (D) field strength as specified in Table 1 of Section 2.1, the EHAAT and the maximum ERP of the desired station. Then the Undesired (U_{NS} and U_{FS}) field strengths are computed using the following formulas:

$U_{NS} = D – D/U_{iv} + FB$, in the near-side case and,

$U_{FS} = D – D/U_{iv}$, in the far-side case.

where:

FB is the front-to-back ratio of the receive antenna in dB, given in Table E2 of Section E3;

D/U_{iv} in dB is the system input voltage protection ratio as given in Tables E4 and E5 of Section E4;

D is the desired field strength in dB and U is the undesired field strength in dB;

U_{NS} is the undesired field strength in dB for the near-side; U_{FS} is the undesired field strength in dB for the far-side.

Once the undesired field strength values are computed (U_{NS} and U_{FS}), one can then use the undesired station's ERP and EHAAT, together with the F(50,10) propagation statistics given in Annex F, to calculate the minimum required distances between the undesired station and the edges of the circle ($dist_{UNS}$ and $dist_{UFS}$).

In order to compute the required distance to protect the desired station, the radius of the previously defined circle ($dist_P$) is then added to $dist_{UNS}$ in the near-side case or subtracted from $dist_{UFS}$ in the far-side case:

$distREQ_{ns} = 1.12\times(dist_P + dist_{UNS})$ in the near-side case

$distREQ_{fs} = 1.12\times(dist_{UFS} - dist_P)$ in the far-side case

where:

$dist_P$ = is the radius of the circle computed using the propagation statistics F(50,90) given in Annex F; the Desired (D) field strength as specified in Table 1 of Section 2.1; the EHAAT and the maximum ERP of the desired station;

$dist_{UNS}$ = is the minimum required distance between the undesired station and the near-side edge of the circle, computed with the F(50,10) propagation statistics; and

$dist_{UFS}$ = is the minimum required distance between the undesired station and the far-side edge of the circle, computed with the F(50,10) propagation statistics.

Once the far-side distance and the near-side distance values are computed using the equations in this Section, one should retain the maximum of the two as the required separation distance to protect the desired station.

As the desired station also needs to protect the undesired station from interference, it is also necessary to calculate the required distance in order to protect the undesired station. The same procedure is carried out using the former desired station as the current undesired one and the former undesired station as the current desired one. The final required separation distance is the maximum of the required distance to protect the desired station and the required distance to protect the undesired station.

Two stations are considered to be short-spaced if the distance between the stations is less than the required separation distance calculated. As a result, a more detailed interference analysis is needed to determine the interference using the method in Section E6 of this annex.

E3. Antenna Patterns

E3.1 Receiving Antenna Pattern

The receiving antenna is assumed to have a directional gain pattern, which tends to discriminate against off-axis undesired stations. This pattern is a planning factor affecting interference. The attenuation, in dB, provided by the assumed receiving pattern is:

For $\theta < 90$ degrees:

Low VHF: MAX (–10, $20\log(\cos^4(\theta))$)
High VHF: MAX (–12, $20\log(\cos^4(\theta))$)
UHF: MAX (–14, $20\log(\cos^4(\theta))$)

For $\theta \geq 90$ degrees, the attenuation is at its maximum value as in Table E2 below.

where:

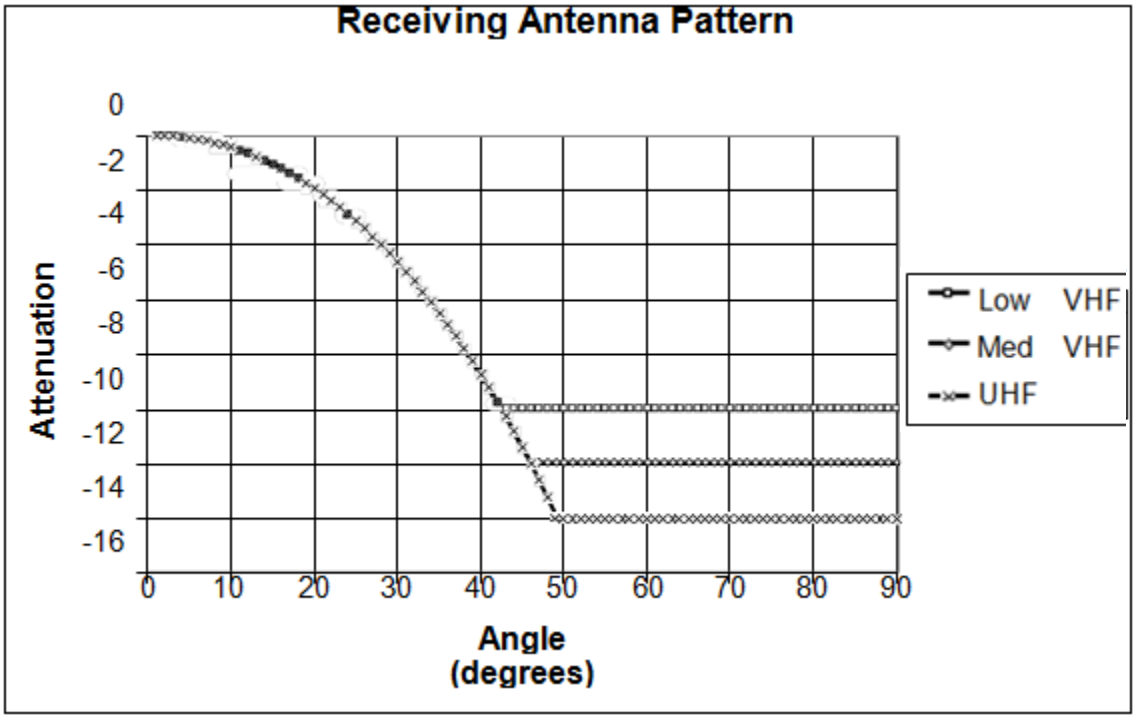
θ is the angle between the lines joining the desired and undesired stations to the reception point.

When the undesired station is far off-axis, the maximum discrimination given by the front-to-back ratio is attained.

Table E2: Front-to-Back Ratios Assumed for Receiving Antennas

Front-to-Back Ratios (dB)		
Low VHF	High VHF	UHF
10	12	14

Figure E1: Receiving Antenna Pattern



E3.2 Transmitting Antenna Pattern

The transmitting antenna is assumed to have a vertical gain pattern as per Table E3. The gain between 90 degrees above the horizontal and 0.75 degrees below the horizontal is 1.00.

Table E3: Vertical Patterns for Transmitting Antennas

Angle (degrees)	Gain in Vertical Plane (relative field strength)				
	Low VHF Analog and DTV	High VHF		UHF	
		Analog	DTV	Analog	DTV
0.75	1.000	1.000	1.000	1.000	1.000
1.50	1.000	0.950	0.970	0.740	0.880
2.00	0.990	0.860	0.940	0.520	0.690
2.50	0.980	0.730	0.890	0.330	0.460
3.00	0.970	0.600	0.820	0.220	0.260
3.50	0.950	0.470	0.730	0.170	0.235
4.00	0.930	0.370	0.650	0.150	0.210
5.00	0.880	0.370	0.470	0.130	0.200
6.00	0.820	0.370	0.330	0.110	0.150
7.00	0.740	0.370	0.280	0.110	0.150
8.00	0.637	0.310	0.280	0.110	0.150
9.00	0.570	0.220	0.280	0.110	0.150
10.00	0.480	0.170	0.250	0.110	0.150

Figure E2: DTV Transmitting Antenna Pattern (Vertical)

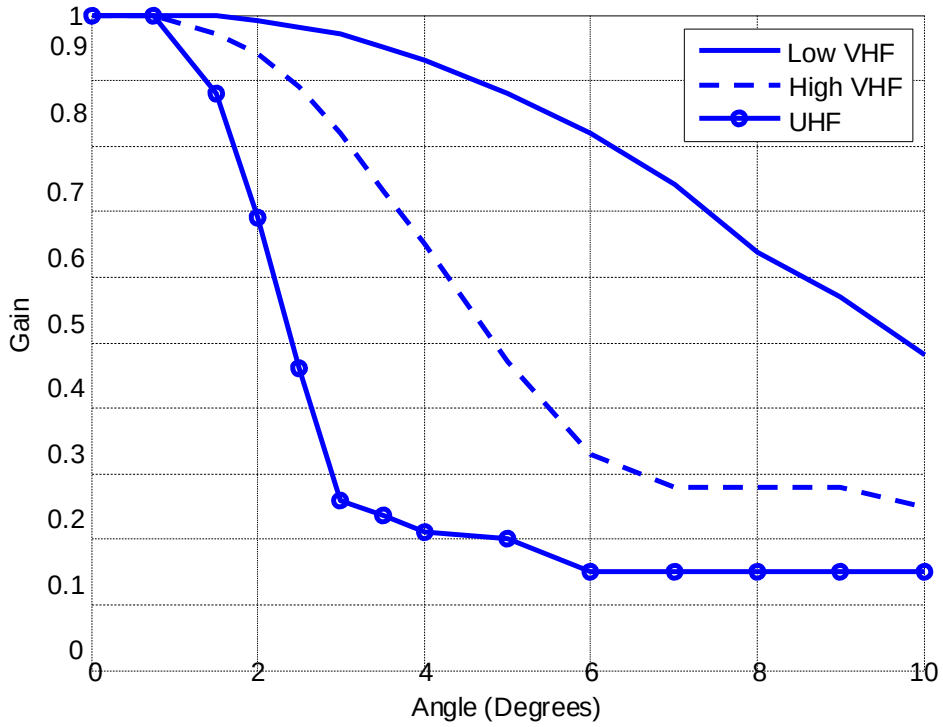
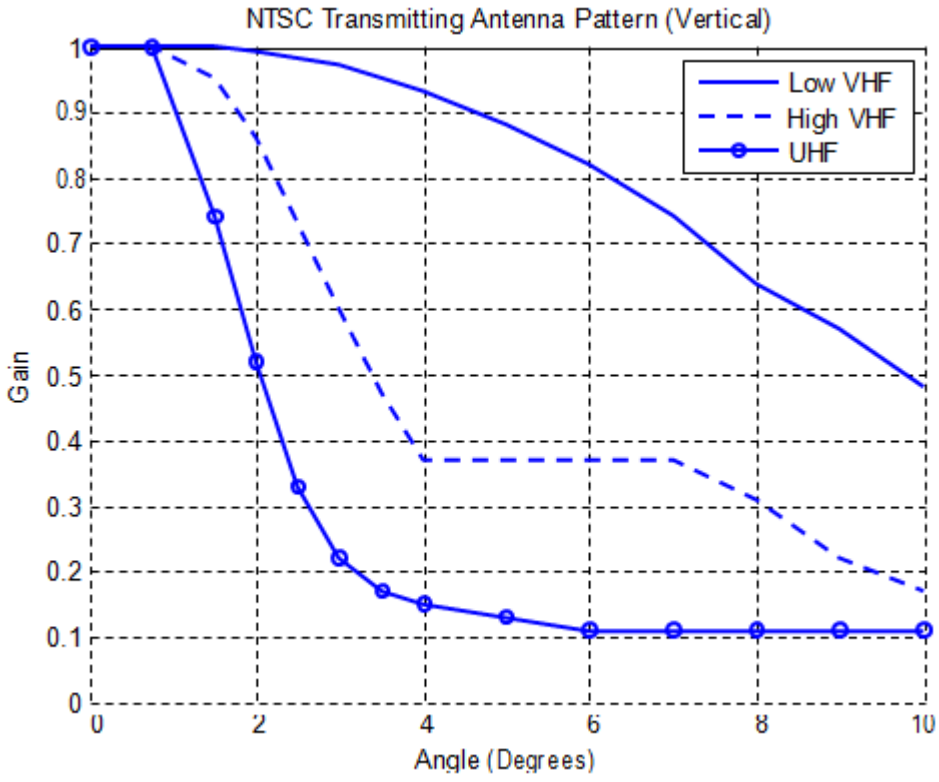


Figure E3: NTSC Transmitting Antenna Pattern (Vertical)



E4. Desired-to-Undesired (D/U) Input Voltage Ratios

E4.1 DTV

Criteria for the ratio of desired-to-undesired input voltage are summarized in the following table.

Table E4: Interference Criteria for Co-channel and Adjacent Channel Assignments and Allotments

Interfering Channel Offset Relative to Protected Channel	D/U Ratio (dB)
–1 (Lower Adjacent)	–28
0 (Co-Channel)	+15*
+1 (Upper Adjacent)	–26

* The D/U ratio for co-channel interference in tables E4 and E5 is only valid at locations where the signal-to-noise (S/N) ratio is 28 dB or greater. At the noise-limited bounding contour, where the S/N ratio is 16 dB, the co-channel D/U ratio is 23 dB. At locations where the S/N ratio is greater than 16 dB, but less than 28 dB, D/U values for co-channel interference are as follows:

$$D/U = 15 + 10\log_{10}[1.0/(1.0–10^{-x/10})],$$

where:

$$x = S/N – 15.19 \text{ dB}$$

The quantity “x” is the amount by which the desired S/N ratio exceeds the minimum required for DTV reception.

This adjustment is made to the co-channel D/U ratios to account for degradation due to increased noise when the S/N ratio is near the limiting value for reception.

E4.2 LPDTV

As LPDTV assignments may operate with one of three different emission masks, first-adjacent protection ratios should be adjusted accordingly. These D/U ratios are applied to LPDTV assignments for all their respective first-adjacent protection requirements.

Table E5: Co-channel and First-Adjacent Interference Criteria for LPDTV Assignments

Interfering Channel Offset Relative to Protected Channel	D/U Ratio (dB)
–1 (Lower Adjacent) +1 (Upper Adjacent) for Simple Mask	–7
–1 (Lower Adjacent) +1 (Upper Adjacent) for Stringent Mask	–12
–1 (Lower Adjacent) +1 (Upper Adjacent) for Full Mask	−28 −26
0 (Co-Channel)	+15*

* see Table E4

E4.3 DTV and LPDTV

Co-channel and first-adjacent interference criteria for protecting DTV from LPDTV are summarized in the following table.

Table E6: Interference Criteria for Co-channel and Adjacent Channel Assignments and Allotments

Interfering Channel Offset Relative to Protected Channel	D/U Ratio (dB)
–1 (Lower Adjacent) +1 (Upper Adjacent) for Simple Mask	–7
–1 (Lower Adjacent) +1 (Upper Adjacent) for Stringent Mask	–12
–1 (Lower Adjacent) +1 (Upper Adjacent) for Full Mask	−28 −26
0 (Co-Channel)	+15*

* see Table E4

Co-channel and first-adjacent interference criteria for calculating interference from DTV to LPDTV are summarized in the following table.

Table E7: Interference Criteria for Co-channel and Adjacent Channel Assignments and Allotments

Interfering Channel Offset Relative to Protected Channel	D/U Ratio (dB)
–1 (Lower Adjacent)	–28
0 (Co-Channel)	+15*
+1 (Upper Adjacent)	–26

* see Table E4

E5. D/U Field Strength Ratio

The desired-to-undesired (D/U) field strength ratio in dB can be derived from the ratio of tables E4 and E5 and from the directional gain pattern (GP) in dB of the receiving antenna as described in Section E3.

$$\text{D/U (Field Strength)} = \text{D/U (Input Voltage)} - |\text{GP}|$$

The required D/U field strength ratio at the edge of the noise-limited bounding contour on the near side can be calculated by using the front-to-back (FB) ratio in dB in Table E2 of Section E3.

$$\text{D/U (Field Strength)} = \text{D/U (Input Voltage)} - \text{FB}$$

Therefore, the DTV required D/U field strength ratios at the edge of the noise-limited bounding contour on the near side are:

Table E8: DTV Required D/U Field Strength Ratios at the Edge of the Noise-limited Bounding Contour on the Near Side

	Required D/U field strength ratio (dB)		
Interfering Channel Offset Relative to Protected Channel	Low VHF	High VHF	UHF
–1 (Lower Adjacent)	–38	–40	–42
0 (Co-Channel)	13	11	9
+1 (Upper Adjacent)	–36	–38	–40

E6. Interference Calculations

The interference analysis should be based on a terrain-sensitive method, such as the Longley-Rice model, using the appropriate time and location statistics. The area within a station's noise-limited bounding contour is normally divided into square cells. The coordinates of the census blocks inside each cell are retrieved along with the population of each block. The census blocks should be based on the latest available Statistics Canada census data. From this information, the total population and the coordinates of the cell centroid are determined for each cell. It is suggested that a square cell size of 2 km or less on a side be used.

First, the desired field strength is evaluated for each cell within the noise-limited bounding contour. A radio path between the desired DTV transmitter and the population centroid of each cell is examined using a terrain-sensitive propagation model applied for the median situations for 50% of locations,

90% of the time at a receiver antenna height of 10 m above ground. The interference analysis retains only those population cells that have been determined to have desired field strength above the threshold for reception given in Tables 1 and 2 of Section 2. Radio paths between undesired DTV transmitters and the point representing protected population are examined. For each such radio path, a terrain-sensitive propagation model is applied for median situations for 50% of locations, 10% of the time at a receiver antenna height of 10 m above ground. The terrain elevations data used in the analysis should be based on Canadian Digital Elevation Data (CDED) or United States Geological Survey (USGS). A protected population cell being examined is counted as having interference if the ratio of desired-to-undesired input voltage from each interference source is less than the critical minimum values given in Section E4 of this Annex. It should be noted that the comparison is made after applying the discrimination effect of the receiving antenna.

E7. Calculation of Population Service Loss

The population service loss caused by the new proposal is calculated as:

$$\%\ Population\ \ Service\ Loss\ = \frac{A}{B} \times 100\,\%$$

where:

A = the population within the protected area predicted to receive interference from only the new DTV proposal, and

B = the population within the protected area

Annex F - Use of Field Strength Charts

To use the charts to predict the distance to a given contour, follow this procedure:

- Convert the ERP in kW for the appropriate azimuth into decibel value referenced to 1 kW (dBk).
- Subtract the power value in dBk from the contour value in dBµV/m. Note that for power less than 1 kW, the difference value will be greater than the contour value because the power in dBk is negative.
- Locate the difference value obtained on the vertical scale at the left edge of the chart.
- Follow the horizontal line for that value into the chart to the point of intersection with the vertical line above the HAAT for the appropriate azimuth located on the scale at the bottom of the chart.
- If the point of intersection does not fall exactly on a distance curve, interpolate between the distance curves below and above the intersection point. The distance values for the curves are located along the right edge of the chart.
- In directions where the terrain is such that negative antenna heights or heights below 30 metres for the 3 to 16 km sector are obtained, an assumed height of 30 metres shall be used for the prediction of field strength.
- For the purposes of estimating field strength, when using the propagation curves in this annex, any HAAT values exceeding 1600 metres must be entered as 1600 metres.

Figure F1

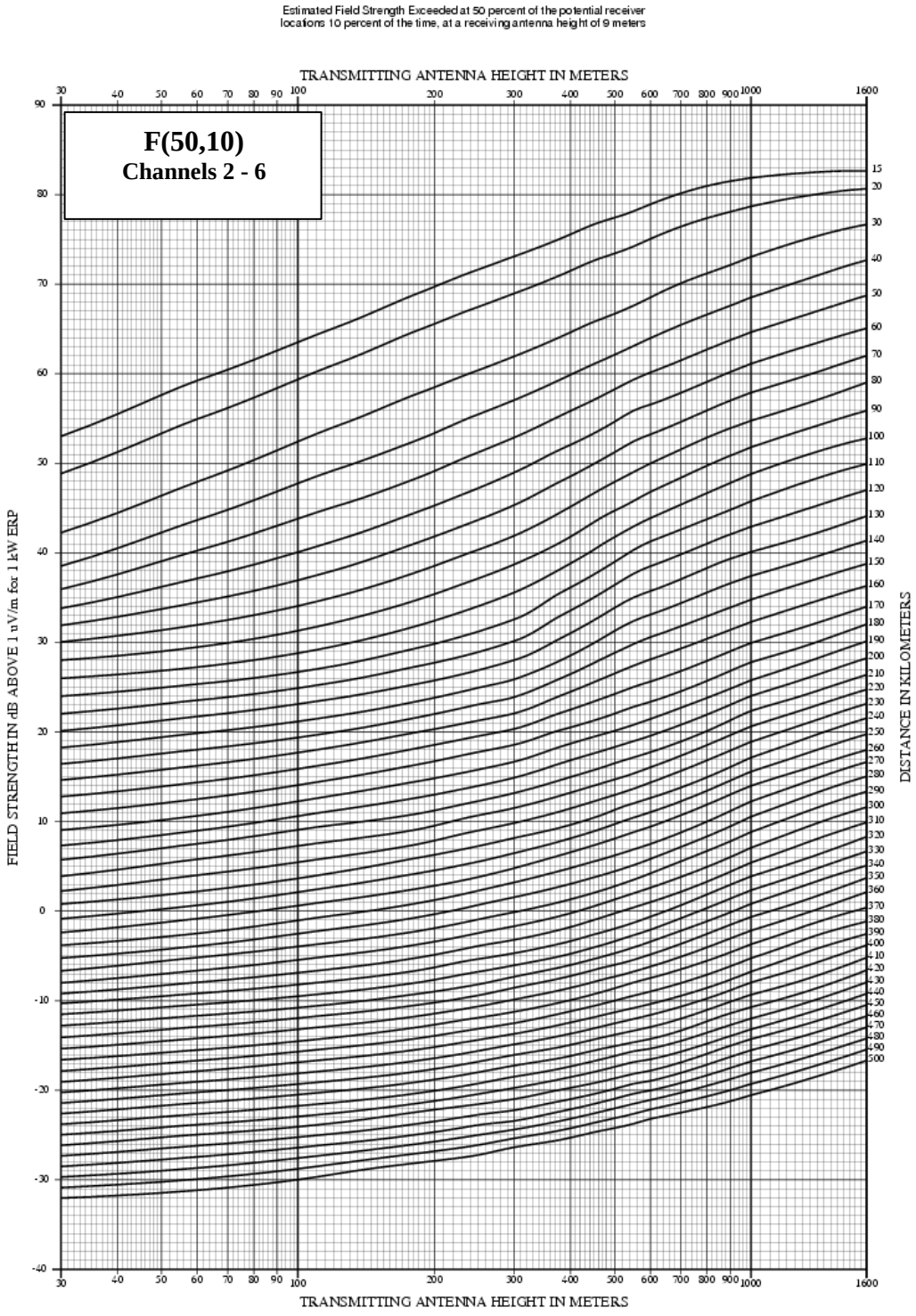

Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 10 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,10)
Channels 2 - 6
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Figure F2

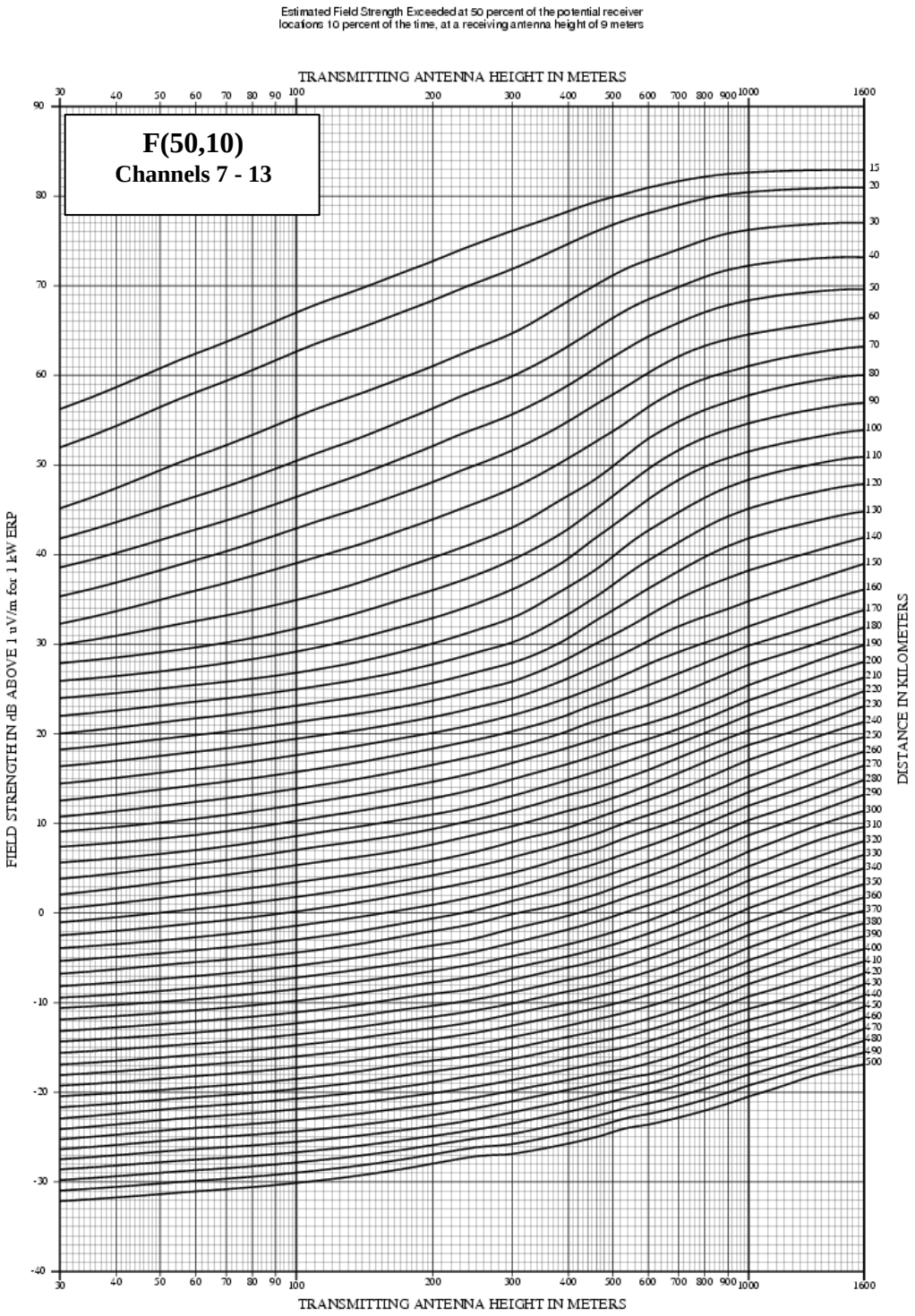

Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 10 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,10)
Channels 7 - 13
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Figure F3

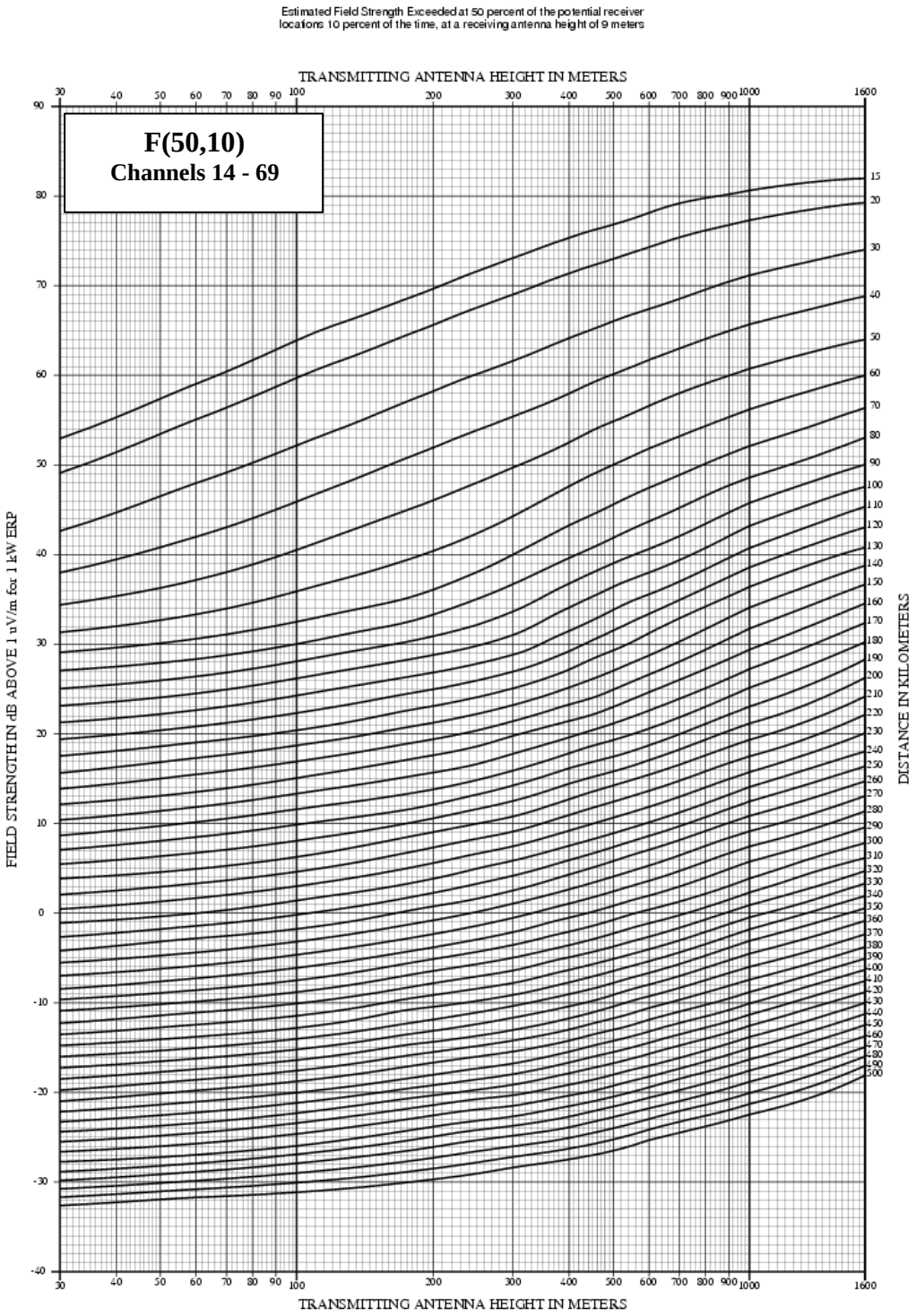

Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 10 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,10)
Channels 14 - 69
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Figure F4

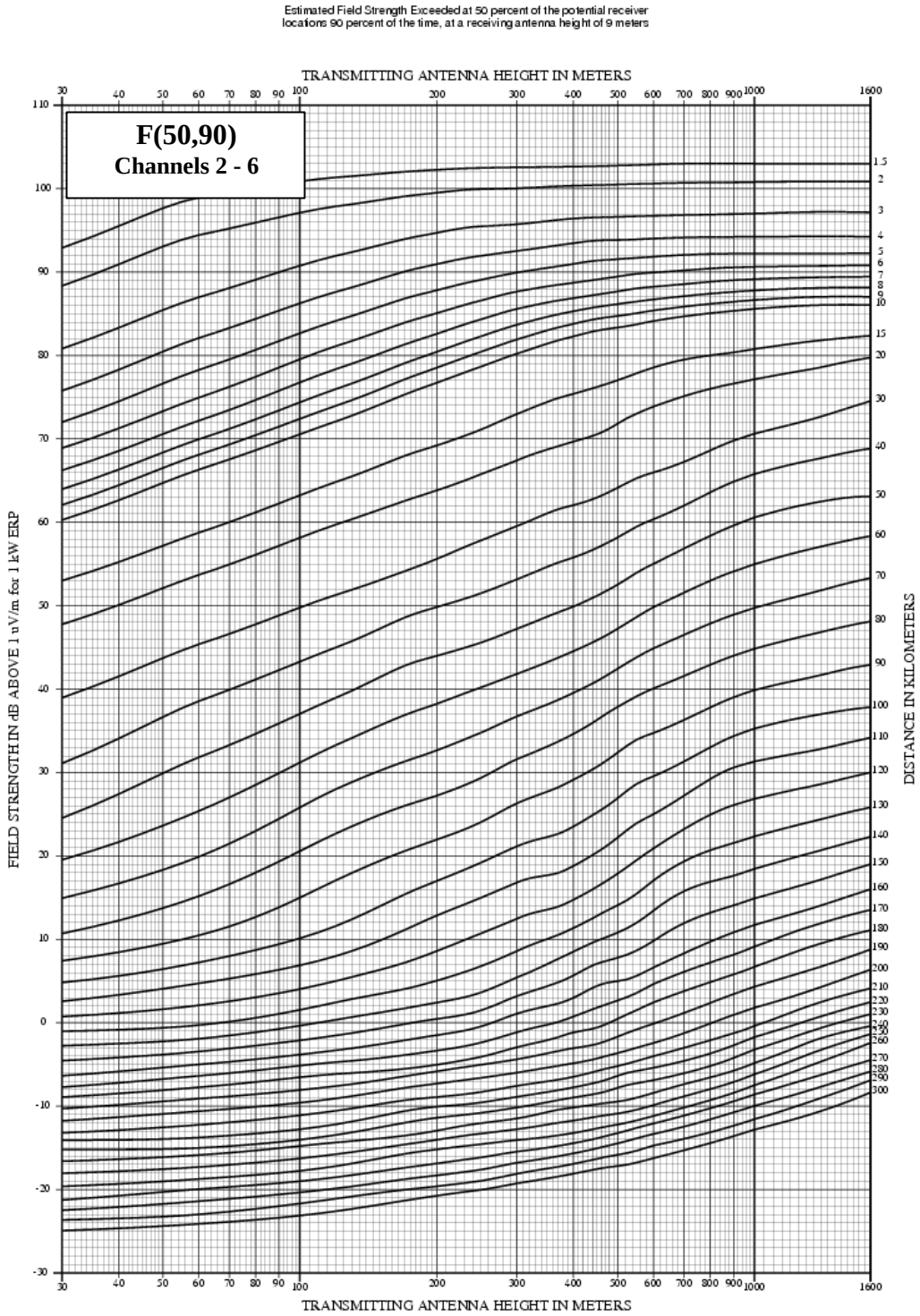

Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 90 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,90)
Channels 2 - 6
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Figure F5

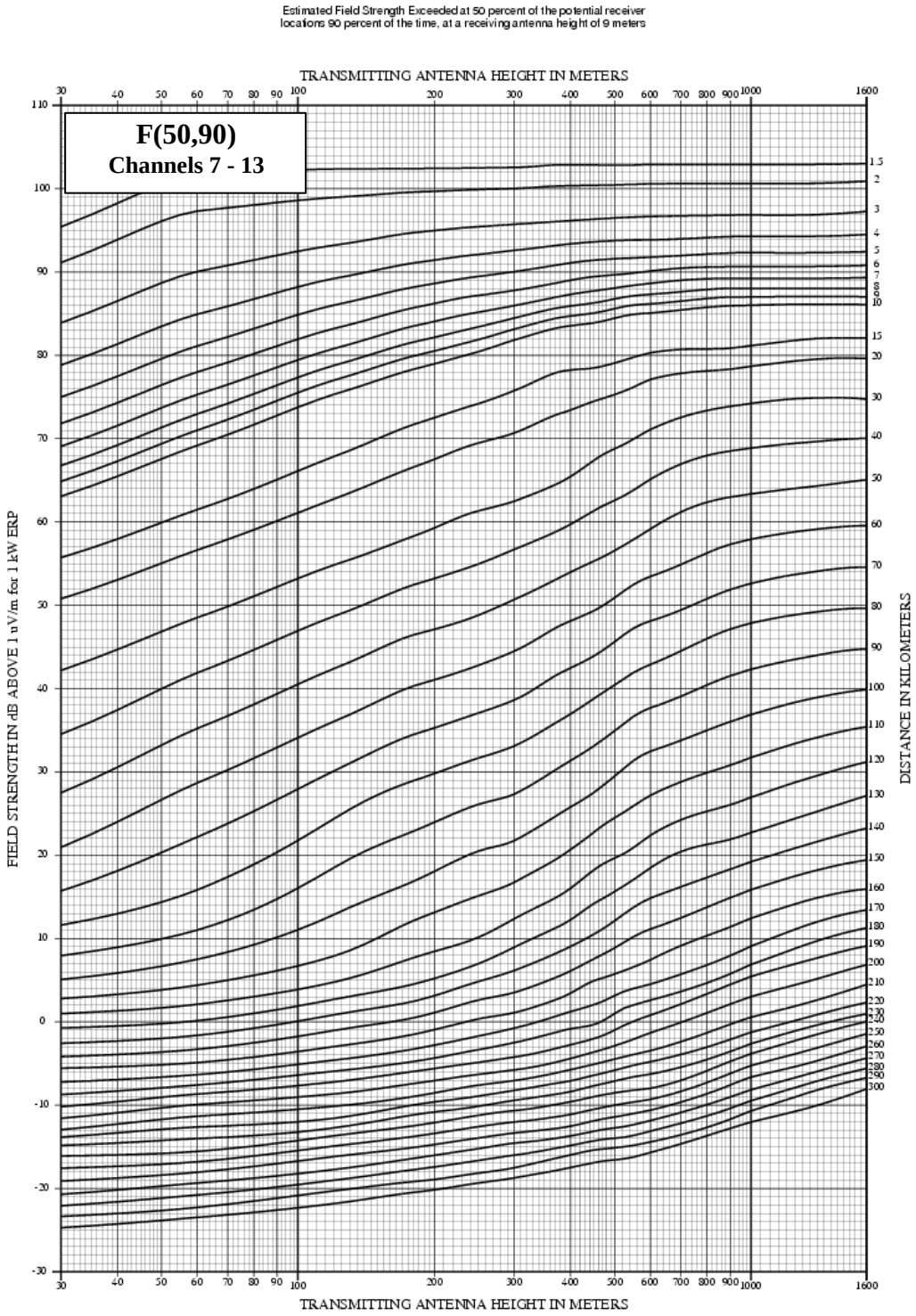

Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 90 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,90)
Channels 7 - 13
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Figure F6

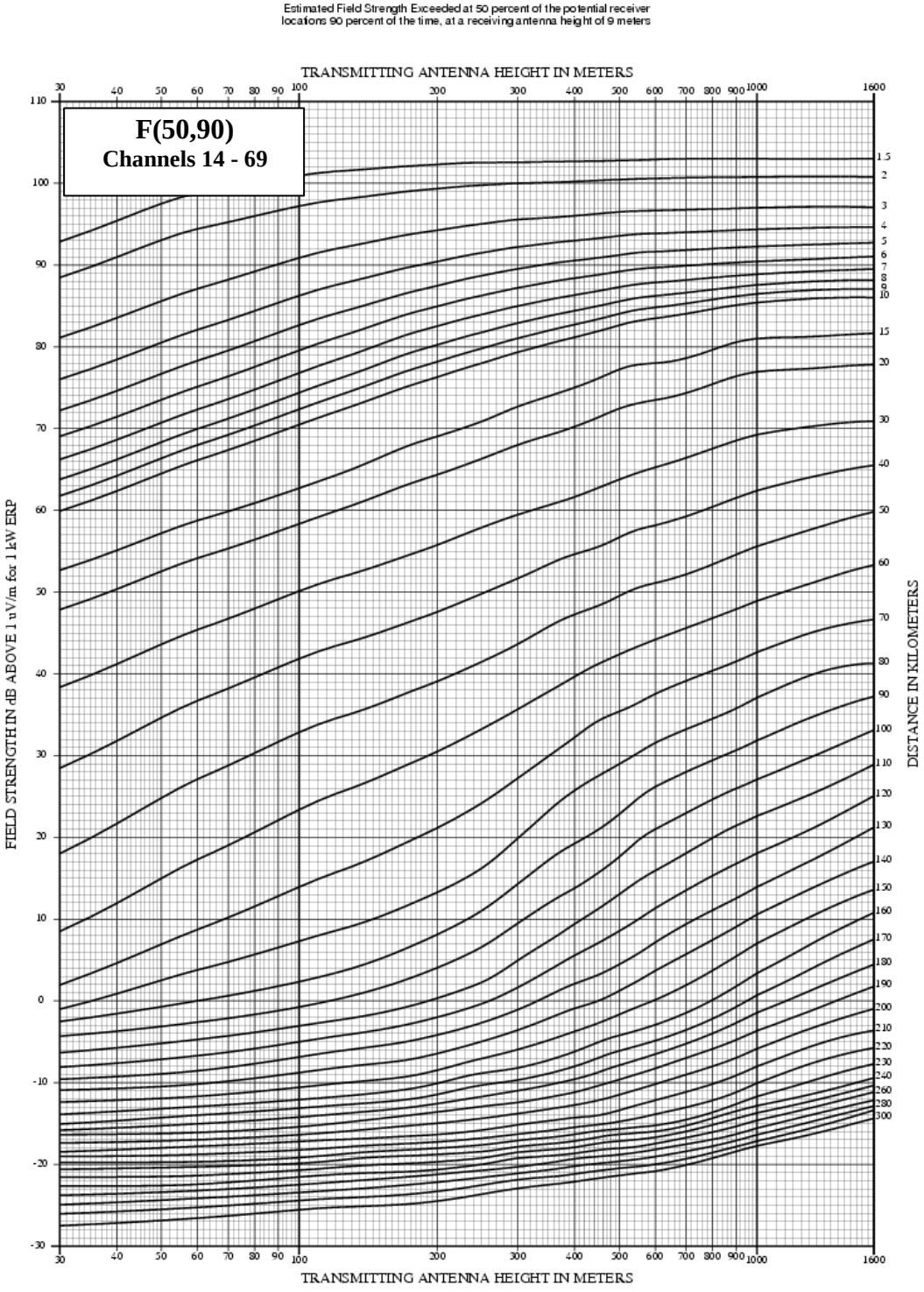

Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 90 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,90)
Channels 14 - 69
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Figure F7

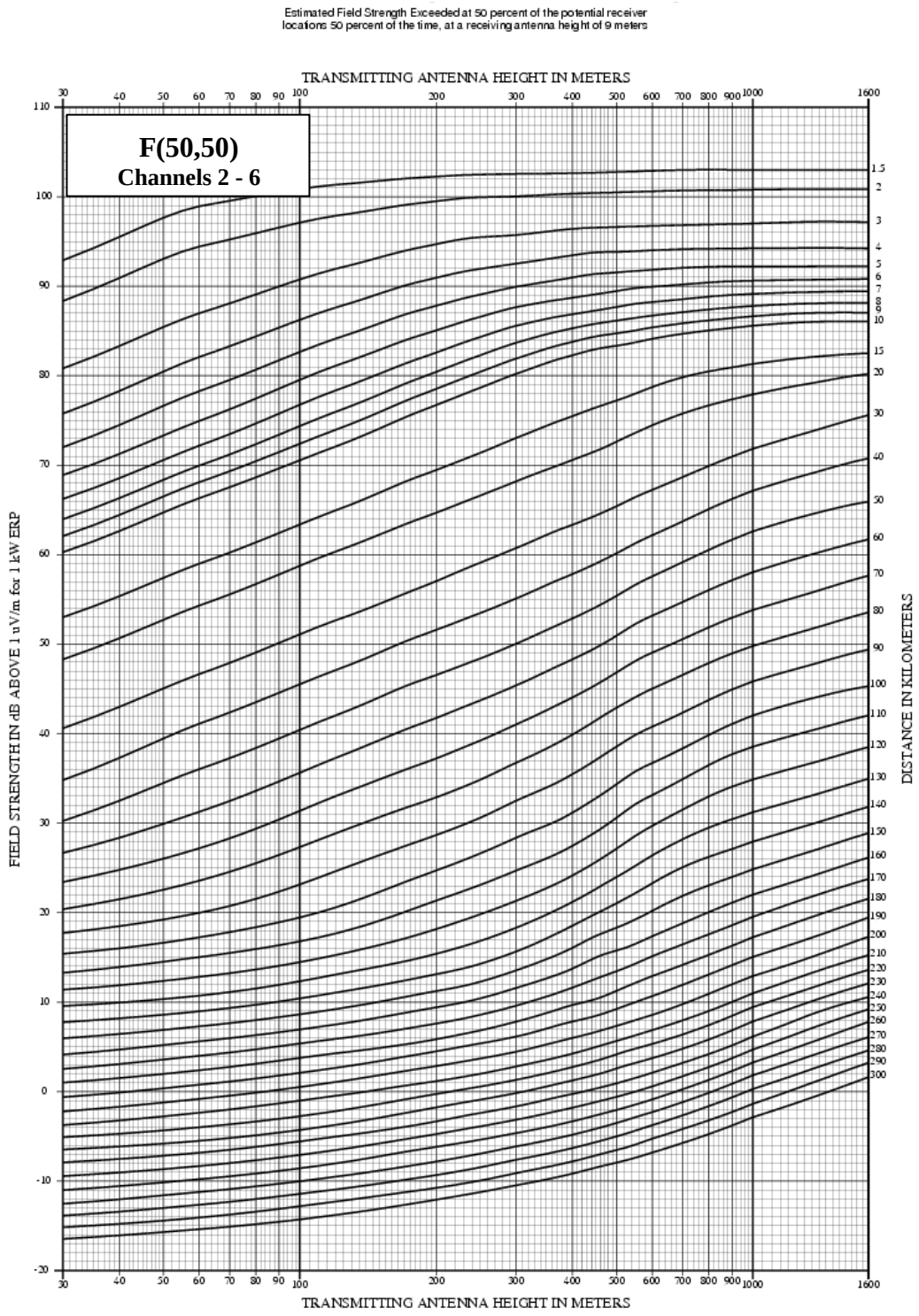

Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 50 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,50)
Channels 2 - 6
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Figure F8

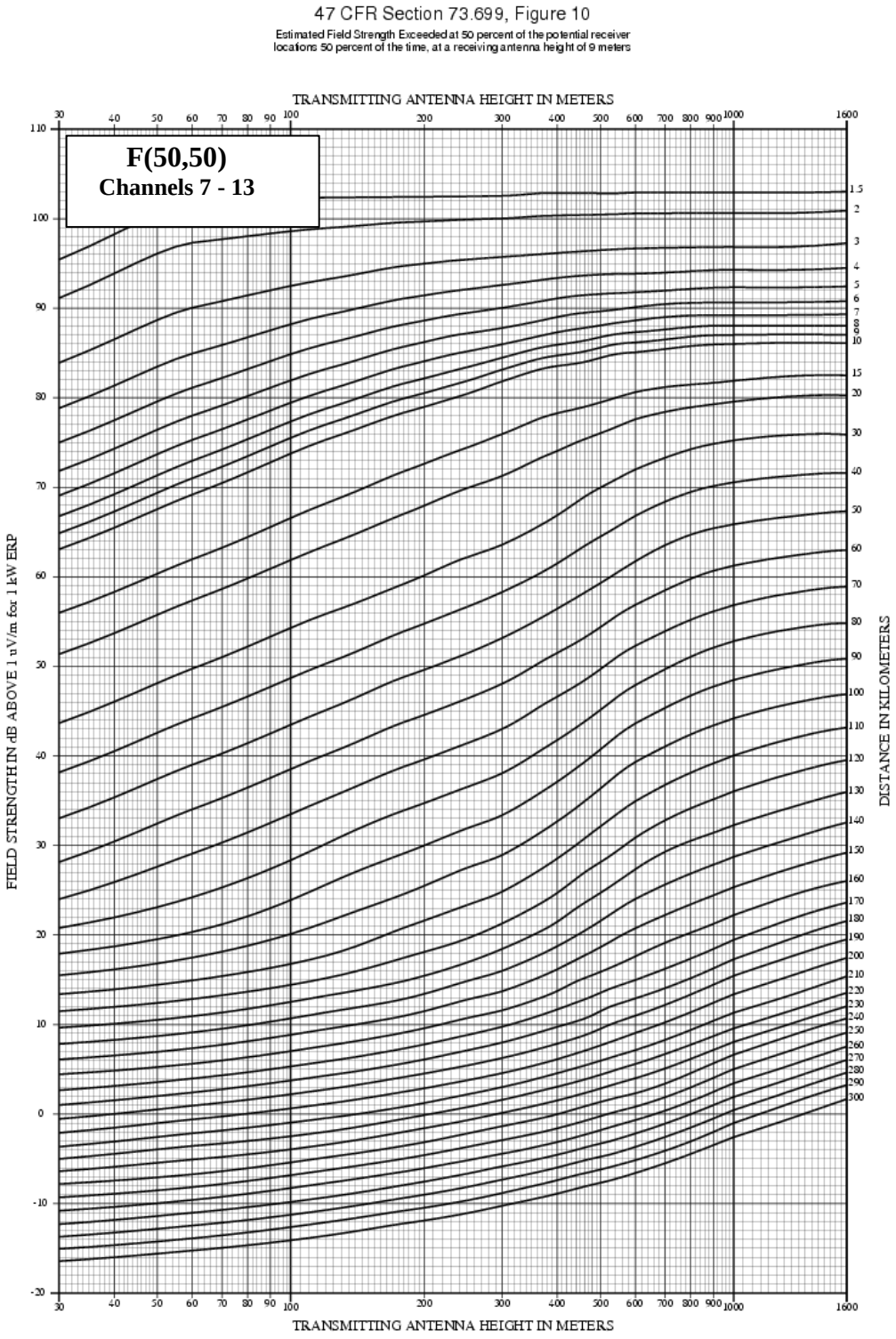
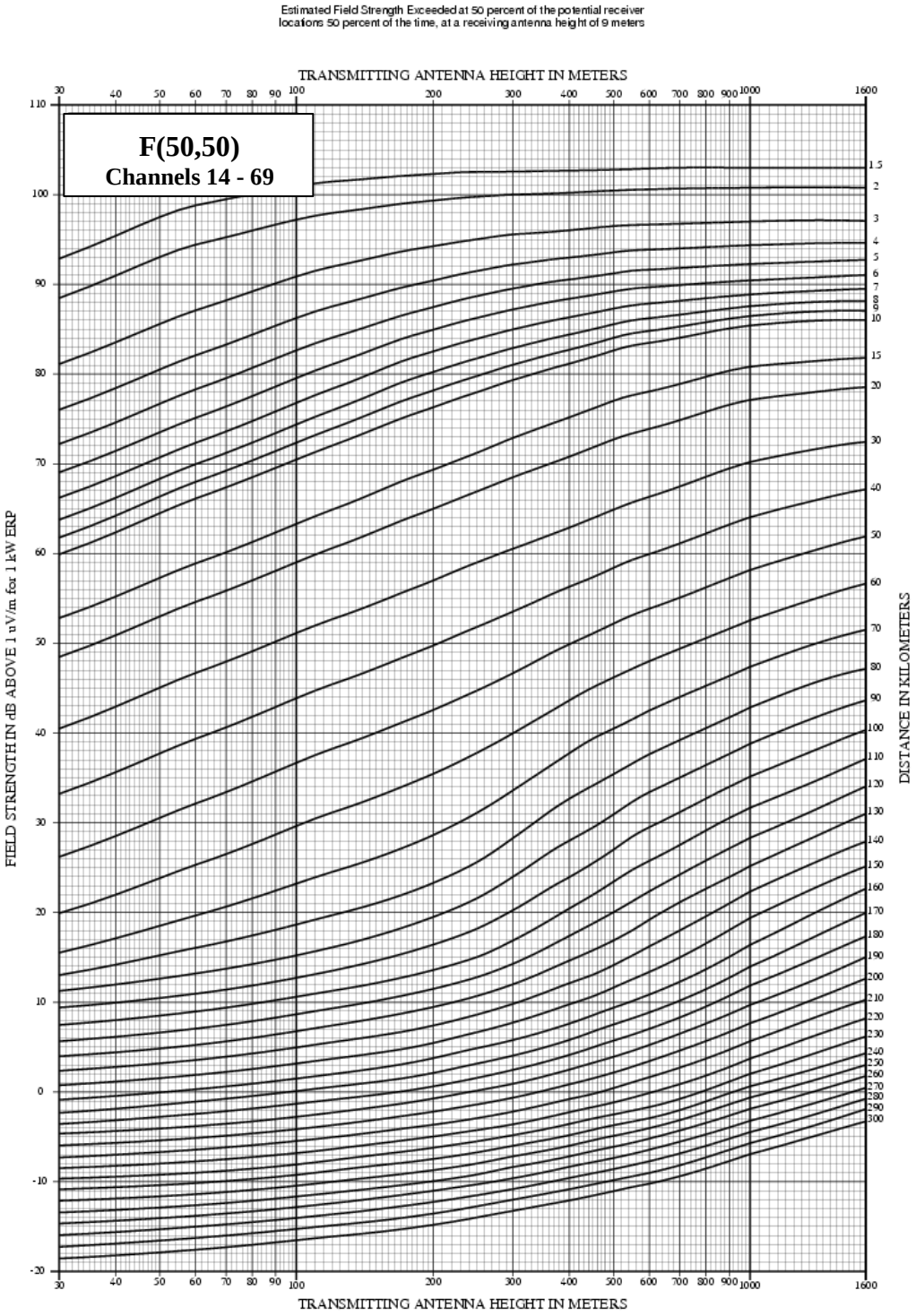

47 CFR Section 73.699, Figure 10
Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 50 percent of the time, at a receiving antenna height of 9 meters
F(50,50)
Channels 7 - 13
TRANSMITTING ANTENNA HEIGHT IN METERS
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS

Figure F9


Estimated Field Strength Exceeded at 50 percent of the potential receiver locations 50 percent of the time, at a receiving antenna height of 9 meters
TRANSMITTING ANTENNA HEIGHT IN METERS
F(50,50)
Channels 14 - 69
FIELD STRENGTH IN dB ABOVE 1 uV/m for 1 kW ERP
DISTANCE IN KILOMETERS
TRANSMITTING ANTENNA HEIGHT IN METERS

Annex G - Interference Analysis between DTV Assignments or Allotments and National Television Systems Committee (NTSC) Assignments

This Annex describes the interference analysis between NTSC and DTV assignments.

G1. NTSC Parameters (For Information Only)

G1.1 NTSC Assignments

The following table provides standard operating parameters of NTSC stations for the three frequency bands.

Table G1: Standard Operating Parameters of NTSC Stations

NTSC Class	UHF		UPPER VHF		LOWER VHF	
	ERP	EHAAT	ERP	EHAAT	ERP	EHAAT
R			325 kW	150 m	100 kW	150 m
C	1 MW	300 m				
B	100 kW	150 m				
A	10 kW	100 m				
LP	5 kW	30 m	400 W	30 m	100 W	30 m

G1.2 Antenna Height and Power Equivalence

Where the antenna height exceeds the values shown in the above table, the effective radiated power (ERP) shall be reduced to provide equivalence with the maximum or other permissible parameters. Equivalence requires that the contours as defined by the field strengths in Table G2 of Section G2.1 remain at the same location.

G2. Interference Analysis

G2.1 Protected Contour

In predicting the distance to the protected service contour of NTSC assignments, the field strengths listed in the second column of Table G2 and the F(50,50) curves should be used. The F(50,50) curves represent the field strength at 9.1 m above ground, which is exceeded at 50% of the locations and 50% of the time as measured in decibels above one microvolt per metre. The curves are based on an effective power of one kilowatt radiated from a half-wave dipole in free space and can be found in Annex F.

The protected area of an NTSC assignment is the geographic area inside the protected service contour where the (50,50) field strength, as predicted using the appropriate effective radiated power (ERP) and a terrain-sensitive propagation model, equals or exceeds the NTSC field strength values as specified in Table G2. Protection is provided within a distance of 89 km for a low VHF regular (R) station, 82 km for a high VHF regular (R) station, 70 km for a Class C UHF station, 45 km for a Class B UHF station, 25 km for a Class A UHF station and 12 km for a low-power (LP) station.

The following table gives the various field strengths of the protected contour for NTSC and DTV assignments or allotments.

Table G2: Contours of DTV and NTSC Assignments

Band (Channels)	DTV Field Strength (dBµV/m)	NTSC Field Strength (dBµV/m)
Low VHF (2-6)	28	47
High VHF (7-13)	36	56
UHF (14-69)	41 – 20 log(615/F)*	64

* where F is the channel mid-frequency in MHz.

G2.2 Separation Distances

The separation distances between various services and channel relationships are to be based on the protection ratios of Section G2.3 of this Annex. The interfering field strength at the protected contour shall be based on the F(50,10) propagation statistics in all cases.

The F(50,10) propagation statistics curves can be found in Annex F.

Assignments and allotments that may be a source of interference are identified as a function of distance and channel relationships. Only those assignments or allotments whose distance from the protected station is less than the value given in Table G3 are considered as potential sources of interference.

Table G3: Culling of Undesired Assignments or Allotments

Interfering Channel Offset Relative to Desired Channel	Maximum Distance from Protected Station to Interfering Station (km)
–1	200
0	450
+1	200
±2, ±3, ±4, ±7, ±8, +14, +15	135

G2.3 DTV/NTSC System Protection Ratios

The system protection ratios are given as input voltage ratios (D/U_{iv}) in the following tables.

Table G4: Co-channels

Interference	D/U_{iv} Ratio (dB)
DTV into NTSC	34
NTSC into DTV	2*

* The D/U ratio for co-channel interference in Table G4 is only valid at locations where the signal-to-noise (S/N) ratio is 25 dB or greater. At the noise-limited bounding contour, where the S/N ratio is 16 dB, the co-channel D/U ratio is 21 dB. At locations where the S/N ratio is greater than 16 dB, but less than 25 dB, D/U values for co-channel interference can be found in Table G5. Use linear interpolation for S/N values between those given in the table.

Table G5: Co-channel D/U Ratios at Various S/N

S/N Ratio (dB)	D/U_{iv} Ratio (dB)
16.00	21.00
16.35	19.94
17.35	17.69
18.35	16.44
19.35	7.19
20.35	4.69
21.35	3.69
22.35	2.94
23.35	2.44
25.00	2.00

This adjustment is made to the co-channel D/U ratios to account for degradation due to increased noise when the S/N ratio is near the limiting value for reception.

Table G6a: Adjacent Channels

Interference	D/U_{iv} Ratio (dB)
Lower DTV into NTSC*	–14
Upper DTV into NTSC*	–17
Lower NTSC into DTV	–48
Upper NTSC into DTV	–49

*** Table G6b: For LPDTV into NTSC, the following D/U ratio applies**

Interfering Channel Offset Relative to Protected Channel	D/U Ratio (dB)
–1 (Lower Adjacent) +1 (Upper Adjacent) for Simple Mask	10
–1 (Lower Adjacent) +1 (Upper Adjacent) for Stringent Mask	0
–1 (Lower Adjacent) +1 (Upper Adjacent) for Full Mask	−14 −17

Table G7: Other Channel Relationships (UHF Only)

DTV into NTSC (Channel N)	
DTV Channel	**D/U_{iv} Ratio (dB)**
N–2	–24
N+2	–28
N–3	–30
N+3	–34
N–4	–34
N+4	–25
N–7	–35
N+7	–43
N–8	–32
N+8	–43
N+14	–33
N+15	–31

G2.4 Evaluation of Separation Distances

Depending on the relative strength of the two stations involved, separation distances may be based on the protection of the contour on the near side or the far side. The required distance between adjacent channels is based on the near-side value, whereas the required distance between co-channels is based on the maximum of the near side and far side, whichever gives the largest distance. Both cases are calculated at the edge of a circle with a radius $dist_P$ around the desired station, which corresponds to the existing

assignment to be protected. The $dist_P$ can be computed using the appropriate propagation statistics from Annex F using the Desired (D) field strength as specified in Table G2 of Section G2.1, the overall EHAAT and the maximum ERP of the desired station. If the desired station is an NTSC, one should use the F(50,50) statistics and if it is a DTV, the F(50,90) statistics should be used. The undesired (U_{NS} and U_{FS}) maximum acceptable field strengths for the proposed assignment or allotment are computed with the following formulas:

$$U_{NS} = D - D/U_{iv} + FB \quad \text{in the near-side case and}$$

$$U_{FS} = D - D/U_{iv} \quad \text{in the far-side case}$$

where:

FB is the front-to-back ratio of the receive antenna in dB, given in Table G8;

D/U_{iv} in dB is the system input voltage protection ratio as given in the tables in Section G2.3;

D is the desired field strength in dB;

U_{NS} is the undesired field strength in dB for the near side; and

U_{FS} is the undesired field strength in dB for the far side.

The front-to-back ratios for different bands are given in the table below:

Table G8: Front-to-Back Ratio (dB)

Channels	NTSC Station	DTV Station
2-6	6	10
7-13	6	12
14-69	6	14

Once the undesired field strength values are computed (U_{NS} and U_{FS}), one can then use the undesired station's maximum ERP and overall EHAAT, together with the F(50,10) propagation statistics given in Annex F to calculate the minimum required distances between the undesired station and the edges of the circle ($dist_{UNS}$ and $dist_{UFS}$).

In order to compute the total required distance to protect the desired station, the radius of the previously defined circle ($dist_P$) is then added to $dist_{UNS}$ in the near-side case or subtracted from $dist_{UFS}$ in the far- side case:

$$dist_{REQns} = 1.12\times(dist_{UNS} + dist_P) \quad \text{in the near-side case}$$

$$dist_{REQfs} = 1.12\times(dist_{UFS} - dist_P) \quad \text{in the far-side case}$$

where:

$dist_P$ is the radius of the circle computed with the appropriate propagation statistics using the desired (D) field strength (Table G2, Section G2.1 of this Annex), the maximum ERP and the overall EHAAT of the desired station;

$dist_{UNS}$ is the minimum required distance between the undesired station and the near-side edge of the circle, computed with the F(50,10) propagation statistics; and

$dist_{UFS}$ is the minimum required distance between the undesired station and the far-side edge of the circle, computed with the F(50,10) propagation statistics.

Once the far side and the near side distance values are computed using the equations in this Section, one should retain the maximum of the two as the required distance to protect the existing assignment.

As it is also necessary to identify the possibility of interference from the existing assignment to the proposed assignment, the procedure shall be repeated, using the existing assignment (former desired station) as the current undesired station and the proposed assignment as the desired one.

Once both procedures have been repeated, the required distance between the two assignments is the greater of the two calculated distances.

G2.5 Short-Spacing and Interference Analysis

This Section describes the procedure to be followed when the distance between two stations/allotments is less than the required separation distance calculated as described in Section G2.4 of this Annex.

For the interference calculations, the receiving antenna is assumed to have a directional gain pattern, which tends to discriminate against off-axis undesired stations. The receiving antenna pattern for DTV stations is given in Section E3.1 of Annex E. The receiving antenna pattern for NTSC stations has an attenuation, in dB, of $MAX(-6,\ 20\log(\cos^4(\theta))\ )$, where θ is the angle between the lines joining the desired and undesired stations to the reception point. The transmitting antenna is assumed to have a vertical gain pattern as indicated in Section E3.2 of Annex E.

G2.5.1 Interference Calculations

The interference analysis should be based on a terrain-sensitive method, such as the Longley-Rice model or PREDICT 2.08r2 software, using the appropriate time and location statistics. The area within a station's protected service contour is normally divided into square cells. The coordinates of the census blocks inside each cell are retrieved along with the population of each block. The census blocks should be based on the 2001 Statistics Canada census data. From this information, the total population and the coordinates of the cell centroid are determined for each cell. It is suggested that a square cell size of 2 km or less on a side be used.

First, the desired field strength is evaluated for each cell within the protected service contour. A radio path between the desired TV transmitter and the population centroid of each cell is examined using a terrain-sensitive propagation model applied for the median situations for 50% of locations, 50% of the time at a receiver antenna height of 10 m above ground. The interference analysis retains only those population cells that have been determined to have desired field strength above the threshold for reception given in

Table G2 of this Annex. Radio paths between undesired DTV transmitters and the point representing protected population are examined. For each such radio path, a terrain-sensitive propagation model is applied for median situations for 50% of locations, 10% of the time at a receiver antenna height of 10 m above ground. The terrain elevations data used in the analysis should be based on 3 arc second data from the most recent Canadian Digital Elevation Data (CDED) or United States Geological Survey (USGS). A protected population cell being examined is counted as having interference if the ratio of desired-to-undesired input voltage from each interference source is less than the D/U ratios given in Section G2.3 of this Annex. It should be noted that the comparison is made after applying the discrimination effect of the receiving antenna.

G2.5.2 Calculation of Population Service Loss

The population service loss caused by the new proposal is calculated as:

$$\%\ Population\ \ Service\ \ Loss\ = \frac{A}{B} \times 100\,\%$$

where:

A = the population within the protected area predicted to receive interference from only the new DTV proposal, and

B = the population within the protected area.

Annex H - Planning Factors for DTV Reception

The planning factors shown below led to the values of field strength given in Tables 1 and 2 of Section 2. The field strength values are found by solving the equation:

$$\text{Field (dB}\mu\text{V/m)} = C/N - K_d - K_a - G + L + N_t + N_s$$

These planning factors are assumed to characterize the equipment, including antenna systems, used for home reception. They determine the minimum field strength for DTV reception as a function of frequency band and as a function of channel number in the UHF band.

Table H1: Planning Factors for DTV Reception

Planning Factor	Symbol	Low VHF	High VHF	UHF
Geometric Mean Frequency (MHz)	F	69	194	615
Dipole Factor (dBm-dBµV/m)	K_d	–111.8	–120.8	–130.8
Dipole Factor Adjustment	K_a	None	None	See Text
Thermal Noise (dBm)	N_t	–106.2	–106.2	–106.2
Antenna Gain (dBd)	G	4	6	10
Downlead Line Loss (dB)	L	1	2	4
System Noise Figure (dB)	N_s	10	10	7
Required Carrier to Noise Ratio (dB)	C/N	15	15	15

The adjustment, $K_a = 20 \log[615/(\text{channel mid-frequency in MHz})]$, is added to K_d to account for the fact that the field strength requirements are greater for UHF channels above the geometric mean frequency of the UHF band and smaller for UHF channels below that frequency.