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FOURTH ICTP-URSI-ITU(BDT) COLLEGE ON RADIOPROPAGATION:
Propagation, Informatics and Radiocommunication System Planning

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"Propagation predictions in connection with the planning of terrestrial broadcasting at VHF and UHF"

Lecture 2

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Propagation predictions in connection with the planning of terrestrial broadcasting at VHF and UHF

For the exercises below, use is made of the software PLANTVFM. Great care is needed when entering the input data in order to avoid subsequent errors, both in the running of the program and in the final results. At all times, it is essential to read the instructions given at each point of data entry.

To access the program, go to the directory \PLANTVFM and call PLANTVFM.

1. It is planned to introduce an FM radio service for the urban area of Trieste (45^{O} 39'N, 13^{O} 50'E) on a frequency of 100.00 MHz. The transmitting antenna, of height 75 m, is to be placed 100m above sea level and will be fed by a transmitter of power 50 kW (cable loss = 2 dB). Slant polarization is to be used and the service will be planned for stereo transmissions.

Initial planning is to be based on the use of an isotropic antenna of gain 6 dB. If no special account is taken of the terrain (i.e. take the default value of Δh = 50 m), to what radial distance should the Minimum Usable Field Strength (E_{min}) be achieved? (Use FMS01 as transmitter code).

2. A transmitter is built in Ljubljana (46^{O} 4'N, 14^{O} 50'E) to provide FM stereo broadcasting to an urban environment on a frequency of 99.90 MHz. The antenna, of height 100 m, is located 500 m above sea level and is fed with 100 kW of power (cable loss = 2 dB). Slant polarization is employed. Again, planning is based on an isotropic antenna pattern of gain 5 dB and the degree of terrain irregularity is assumed to be represented by Δh = 50 m. (Use FMS02 as transmitter code).

Does this new service at Ljubljana have any effect on the coverage area of the existing service at Trieste (as described above in 1)?

What is the value of the Usable Field Strength (E_u) of the Trieste service for 90 % and 99 % of the time?

3. More detailed information becomes available on the terrain in the vicinity of Ljubljana and the following values of Δh are calculated for the corresponding radials from the transmitter:

Radial (°)	Δh (m)
190	80
200	100
210	150
220	180
230	190
240	200
250	180
260	170
270	100
280	70

For all other radials, Δh remains at 50 m.

By introducing the above values into the terrain file for Ljubljana, what is now the predicted effect of the Ljubljana transmitter on the service at Trieste?

What is the value of E_u for the Trieste service for 90 % and 99 % of the time?

4. The density of FM radio services increases in the area. Two new transmitters are installed, of which the details are as follows:

Udine (46° 2'N, 13° 18'E) (Use transmitter code FMS03)
100 m above sea level; 50 m Tx antenna height; cable loss 2 dB
FM rural stereo service; 50 kW; slant polarization
100.20 MHz
5 dB gain isotropic antenna
Δh = 50 m

Venice (45° 27'N, 12° 20'E) (Use transmitter code FMS04)
50 m above sea level; 150 m Tx antenna height; cable loss 2 dB
FM urban stereo service; 150 kW; slant polarization
100.10 MHz
6 dB gain isotropic antenna
Δh = 50m

Enter these details into the program and investigate the effect of one transmitter on the service coverage of another.

SECTION 10A-1: AMPLITUDE-MODULATION SOUND BROADCASTING IN BANDS 5 (LF), 6 (MF) and 7 (HF)

RECOMMENDATION 638*

TERMS AND DEFINITIONS USED IN FREQUENCY PLANNING FOR SOUND BROADCASTING**

(Questions 44/10, 46/10)

(1986)

The CCIR

UNANIMOUSLY RECOMMENDS

that for the purpose of frequency planning for sound and television broadcasting, the following terms and definitions should be used:

1. Signal-to-interference ratios

1.1 The *audio-frequency* (AF) *signal-to-interference ratio* is the ratio (expressed in dB) between the values of the voltage of the wanted signal and the voltage of the interference, measured under specified conditions, at the audio-frequency output of the receiver.

This ratio corresponds closely to the difference in volume of sound (expressed in dB) between the wanted programme and the interference.

1.2 The *audio-frequency* (AF) *protection ratio* is the agreed minimum value of the audio-frequency signal-to-interference ratio considered necessary to achieve a subjectively defined reception quality.

This ratio may have different values according to the type of service desired.

1.3 The *radio-frequency* (RF) *wanted-to-interfering signal ratio* is the ratio (expressed in dB) between the values of the radio-frequency voltage of the wanted signal and the interfering signal, measured at the input of the receiver under specified conditions.

1.4 *The radio-frequency* (RF) *protection ratio* is the value of the radio-frequency wanted-to-interfering signal ratio that enables, under specified conditions, the audio-frequency protection ratio to be obtained at the output of a receiver.

The specified conditions include such diverse parameters as: spacing Δf of the wanted and interfering carrier, carrier offset, carrier-frequency tolerance, modulation characteristics (type of modulation, modulation depth, pre-emphasis characteristics, frequency deviation, etc.), characteristics of the AF signal (bandwidth, dynamic compression), receiver input level as well as the receiver characteristics (selectivity and susceptibility to cross-modulation, etc.).

2. Specific field strengths

2.1 *Minimum usable field strength (E_{min})*

Minimum value of the field strength necessary to permit a desired reception quality, under specified receiving conditions, in the presence of natural and man-made noise (see Report 322), but in the absence of interference from other transmitters.

Note 1 – The desired quality is determined in particular by the protection ratio against noise, and for fluctuating noise, by the percentage of time during which this protection ratio must be ensured.

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* This Recommendation should be brought to the attention of the CMV.

** This Recommendation merges Recommendations 447 and 499 which are hereby cancelled.

Note 2 – The receiving conditions include, amongst others:

– the type of transmission, and frequency band used;

– the receiving equipment characteristics (antenna gain, receiver characteristics, siting);

– receiver operating conditions, particularly the geographical zone, the time and the season.

Note 3 – Where there is no ambiguity, the term "minimum field strength" may be used.

Note 4 – The term "minimum usable field strength" corresponds to the term "minimum field strength to be protected" which appears in many ITU texts.

2.2 *Usable field strength (E_u)*

Minimum value of the field strength necessary to permit a desired reception quality, under specified receiving conditions, in the presence of natural and man-made noise and interference, either in an existing situation or as determined by agreements or frequency plans.

Note 1 – The desired quality is determined in particular by the protection ratios against noise and interference and, in the case of fluctuating noise or interference, by the percentage of time during which the required quality must be ensured.

Note 2 – The receiving conditions include, amongst others:

– the type of transmission and frequency band used;

– the receiving equipment characteristics (antenna gain, receiver characteristics, siting);

– receiver operating conditions, particularly the geographical zone, the time and the season, or if the receiver is mobile, the local variations of the field strength due to propagation effects.

Note 3 – The term "usable field strength" corresponds to the term "necessary field strength" which appears in many ITU texts. Use of the latter term is not desirable.

Note 4 – For the determination of the usable field strength see Report 945 for information.

2.3 *Reference usable field strength (E_{ref})*

The agreed value of the usable field strength that can serve as a reference or basis for frequency planning.

Note 1 – Depending on the receiving conditions and the quality required, there may be several reference usable field-strength values for the same service.

Note 2 – Where there is no ambiguity, the term "reference field strength" may be used.

Note 3 – The term "reference usable field strength" corresponds to the term "nominal usable field strength" which appears in some ITU texts.

3. Coverage area (of a broadcasting transmitter in a given broadcasting band)

The area within which the field strength of a transmitter is equal to or greater than the usable field strength.

In the case of fluctuating interference or noise, the percentage of time during which this condition is satisfied should be stated.

The coverage area may be different under day-time and night-time conditions (bands 5, 6 and 7) or vary with other factors.

Note 1 – The coverage area is determined solely by the technical conditions specified, irrespective of administrative or regulatory considerations.

Note 2 – See also Recommendation 573, Vol. XIII.

Hughes

SOFTWARE PACKAGE
FOR THE
PLANNING OF VHF/UHF BROADCASTING SERVICES

CHAPTER I

GENERAL DESCRIPTION

1.1 INTRODUCTION

1.1.1 In accordance with the ABU Rec.5/88, All India Radio had coordinated the development of a software for the analysis of VHF/UHF field strength data being collected by member organisations for the development of Field Strength Prediction Curves, applicable to the tropical zone of Asia-Pacific region. The software was demonstrated to the delegates attending the Standing Engineering Committee meeting held at New Delhi (1990). The software was found to be very useful and it generated lot of interest amongst the delegates attending the meeting. Considering the success of that software, the Standing Engineering Committee-90 recommended that AIR may further coordinate development of a software package for the planning of VHF/UHF broadcasting services. The Engineering Committee also made available a sum of US $5000 for the development of this software (Rec.No.6/90). The work was coordinated by the Research & Development Department of All India Radio, who after carefully examining the technical literature available on the subject finalised the suitable models to be adopted and prepared a detailed algorithm for the development of a computer program.

1.1.2 A computer software firm viz.,M/s Silicon Shilpi System Pvt. Limited, New Delhi, was engaged to develop the software in accordance with the algoritham and guidelines provided by All India Radio, from time to time.

1.2 NEED FOR THE PLANNING OF BROADCAST SERVICES

1.2.1 For the optimum utilisation of the limited RF spectrum available, the planning of services is most essential. For the planning of FM sound broadcasting and the TV services in the VHF/UHF bands, the theory of regular lattice network is used. For this purpose, a number of assumptions are made:

- all the transmitters have the same power. The antenna characteristics and their height above ground are also the same.
- the propagation of wave is isotropic and is independent of the frequency, within the band to be planned.
- the surrounding area is flat.

1.2.2 However, in practice none of these conditions are fully met. The curvature of the earth and the topography play an important role in deciding the transmitter density. The transmitters are generally located as near to the density of population as possible disturbing the theoretical lattice prepared for spectrum planning.

1.2.3 The planning of broadcasting services in VHF/UHF bands involves very complex procedures. The process gets further complicated in actual practice when transmitters in a broadcasting network make use of different powers, transmitting antenna heights, antenna patterns and polarization, etc. In order to assess the coverage of a transmitter under practical conditions by taking into account the terrain and various interference mechanisms, higher mathematical skills are needed and the process is also very time consuming. Keeping these facts in view, the scope of the software has been worked out in such a manner that it helps in evaluating the performance of an existing transmitter operating within a broadcasting network and also in predicting the performance of a newly planned transmitter to be inducted within an existing network.

1.3 MAIN OBJECTIVES OF THE SOFTWARE

1.3.1 The software has been developed keeping the following objectives in view:

- To evaluate the coverage of a transmitter operating in a broadcasting network taking into account the frequency of operation, effective radiated power, effective transmitting antenna height, terrain parameters and interference from other transmitters in the network.

- Evaluation of technical compatibility, while introducing a new transmitter within an existing network.

- Optimisation of newly planned service by varying the planning parameters like geographical location, frequency of operation, power, transmitting antenna height, etc. and evaluating its effect on the coverage of other transmitters in the existing network.

- To help a planner in determining the most suitable antenna pattern under different terrain conditions, for providing an effective service in the desired target areas.

1.4 MODELS ADOPTED FOR THE PLANNING OF BROADCAST SERVICES

1.4.1 Field Strength Prediction Curves

1.4.1.1 The theoretical calculation of field strength at varying distances from the transmitter is quite an involved process. In practice the clutter losses, terrain irregularity, atmospheric effects, etc. also play an important role in determining the field strength laid by a transmitter at any desired location around the transmitter. Besides, due to the variation of field strength with respect to the location and time probabilities, the number of computations involved in ascertaining the coverage, are too many. The VHF/UHF field strength curves contained in CCIR Rec.370-5 give the variation of field strength as a function of distance for 50% location probability and for different percentages of time probabilities over land, warm sea and cold sea paths. These prediction curves are based on the data collected in the temperate zones. In order to assess the validity of these curves for the Asia-Pacific region, field strength measurements have been carried out in some of the countries in the region and the tentative curves have been drawn. These curves somewhat differ from those available in CCIR Rec.370-5. However, further detailed studies still need to be carried out before any definite conclusion could be drawn. Therefore, eventhough a set of tentative propogation prediction curves for the Asian part of the tropical region are available in the CCIR Report 239-7, the same have not been adopted for the development of the present software and instead the curves given in CCIR Rec.370-5 have been adopted. These curves have been digitised and fed to the computer to form a database. These curves are available at Annex-I. The software has the flexibility to modify the database at a later date, as and when the field strength prediction curves for the tropical region are finalised. For the prediction of field strength over the mixed land and sea-paths, the procedure enumerated in CCIR Report 239-7 has been adopted.

1.4.2 Terrain Irregularity Factor (Δh)

1.4.2.1 The topography of the area around the transmitter also affects the propagation of the signal and thereby the predicted field strength. The factor Δh is used to define the degree of terrain irregularity. CCIR Rec.370-5 defines a method to obtain the terrain irregularity factor by determining the difference between the 10% and 90% of terrain irregularity, between 10 & 50 km distances from the transmitter. The appropriate curves for calculating the attenuation correction factor for the terrain irregularities are reproduced at Annex-II.

1.4.3 Minumum Usable Field Strength

1.4.3.1 FM Sound Broadcasting Services

1.4.3.1.1 For providing a satisfactory FM sound broadcasting service in the presence of man-made noise and under different environmental conditions, the minimum usable field strengths have been defined in CCIR Rec.412-5 and the same have been adopted in the present software. The values specified for different types of services, are as follows:

Service	Minimum usable field strength
- Monophonic service	
Rural areas	48 dB (μV/m)
Urban areas	60 dB (μV/m)
Large cities	70 dB (μV/m)
- Stereophonic service	
Rural areas	54 dB (μV/m)
Urban areas	66 dB (μV/m)
Large cities	74 dB (μV/m)

1.4.3.1.2 The above values of field strength represent the median values of field strength received at a standard height of 10 mt above ground level.

1.4.3.2 TV Broadcasting Services

1.4.3.2.1 For the satisfactory reception of TV signals in the absence of interference, the minimum usable field strength values in different bands have been defined in CCIR Rec.417-3 as given below. These values have been adopted in the present software.

Band I	48 dB (μV/m)
Band III	55 dB (μV/m)
Band IV	65 dB (μV/m)
Band V	70 dB (μV/m)

1.4.3.2.2 These values again refer to the field strength received at a standard receiving antenna height of 10 mt. above ground level.

1.4.4 Radio Frequency Protection Ratio

1.4.4.1 The protection ratios for the co-channel and adjacent channels for FM broadcast services (Mono & Stereo) are defined in the CCIR Rec.412-5. For TV services the values of protection ratios are defined in CCIR Rec.655-1. These recommendations have been adopted for the development of the software. The values of protection ratios for FM and TV services are reproduced in Annex-III & Annex-IV respectively.

1.4.5 Interference Calculations

The coverage of a transmitter depends not only on the natural and man-made noise but it is also limited by the presence of interfering transmitters operating on co-and/or adjacent channels. The level of interference depends on the transmitter parameters, geographical separation between the wanted and interfering transmitters and on the mode of propagation. Depending on the type of service, three distinct possibilities of interference exist;

- Interference to FM Sound Broadcasting Services;
- Interference to the video carrier of TV broadcasts;
- Interference to the sound carrier of TV broadcasts.

1.4.5.1 Interference to FM Sound Broadcasting Services

1.4.5.1.1 A transmitter operating at a frequency of±10.5 to 10.9 MHz with respect to the wanted carrier can be a serious source of interference to the wanted transmission. This type of interference can also be caused by a receiver whose local oscillator operates on a frequency as defined above. However, it is not possible to take into consideration this type of interference while planning a service.

1.4.5.1.2 The transmitters operating on a frequency less than ±400 kHz with respect to the wanted carrier frequency constitutes the primary source of interference to the reception of wanted transmissions. In the present software the transmitters likely to interfere are identified and listed. For the planning of broadcasting services in VHF/UHF bands, the interference limited coverage is determined by protecting the field strength of the desired transmitter for 50% of the locations and for different percentages of time (99%, 95%, 90%). The software provides facility to select any one of the three probabilities. There are two types of interferences:

- Steady interference; where the unwanted signal does not fade.

- Tropospheric interference; where the signal of the unwanted transmitters fades due to propagation through troposphere.

$E_w \geq E_i + PR$

1.4.5.1.3 The protection ratio for both the cases are different. The software determines which type of interference is dominant and applies appropriate protection ratio accordingly.

1.4.5.1.4 In the presence of interference, the usable field strength (E_u) will depend upon the field strength of the unwanted transmitter, the minimum usable field strength, RF protection ratio and the receiving antenna discrimination. If the interference is coming from more than one transmitter, the combined effect of interference can be determined with the help of the method described in Annex-I to CCIR Report 945-2. The usable field strength is determined for a specified coverage probability (with respect to time and location) and it depends on the value of nuisance fields:

$$Esi = Pi + Eni(50,T) + Ai + Bi$$

where, E_{si} : nuisance field corresponding to i-th unwanted transmitter

Pi : the e.r.p. in dB(KW) of the i-th unwanted transmitter.

Eni(50,T): the field strength in dBμV/m of the i-th unwanted transmitter normalised to 1 KW e.r.p. exceeded at 50% of the locations during at least T% (eg;1%, 5% or 10%) of time.

Ai : the radio-frequency protection ratio associated with the unwanted transmitter, expressed in dB;

Bi : the receiving antenna discrimination, expressed in dB.

(Annex I) a Rep 945)

1.4.5.1.5 The nuisance field is calculated at the location of the wanted transmitter. When the receiving antenna discrimination is not applied, Bi is taken as zero. The protection ratios are different for mono and stereo FM services. Appropriate protection ratio is selected by the software depending on the type of service. The effect of multiple interference is taken into account by the use of a stastical computation method known as Simplified Multiplication Method. With this method the usable field strength Eu is given by :

$$Pc = \prod_{i=1}^{n} L(Eu - Esi)$$

$\frac{E_u - E_{si}}{\sigma_n \sqrt{2}}$

where, Pc = the coverage probability [e.g.50% of location,(100-T)% of time].

L = the probability integral for a normal distribution.

σ_n = standard deviation with location of the wanted and interfering field strengths

1.4.5.2 Interference to Video carrier of TV Services

1.4.5.2.1 The procedure for finding interference limited coverage of a TV transmitter is similar to that adopted for calculating the interference limited coverage for a sound broadcasting service. The main difference is in assigning the protection ratio. The following cases of interference are identified and the protection ratios assigned as per CCIR Rec.655-1:

- Co-channel interference;
- Lower adjacent channel interference;
- Upper adjacent channel interference;
- Overlapping channel interference;
- Image channel interference.

1.4.5.2.2 The frequency difference between the video carrier of the wanted transmitter and the interfering transmitter is determined and the type of interference identified. In case of co-channel and overlapping channel interferences, the precision and non-precision conditions of frequency offset are identified and the protection ratio determined accordingly.

1.4.5.3 Interference to Sound carrier of TV Services

1.4.5.3.1 An unwanted transmitter can interfere with the sound carrier of the TV signal if the frequency difference between within ±50 kHz. The interfering transmitters are identified the protection ratio assigned as per CCIR Rec.655-1. The field strength is calculated and a check is carried out to see the sound coverage is affected by the interference from unwanted transmissions.

CHAPTER II

DEVELOPMENT OF THE SOFTWARE

2.1 MAIN FEATURES OF THE SOFTWARE DEVELOPED

The software developed for the planning of VHF/UHF broadcasting services can broadly be divided into four major sectors.

- Input data requirements;
- Analysis of data for the coverage area determination;
- Presentation of results;
- Special features of the software.

2.1.1 INPUT DATA REQUIREMENTS

The software requires three types of basic input data, namely,

- Technical parameters of the transmitter;
- Antenna gain pattern;
- Terrain data.

2.1.1.1 Technical Parameters of the Transmitter

2.1.1.1.1 The technical parameters of the transmitter, whose coverage area is to be determined, are required to be fed to the computer. The transmitter under consideration could either be an existing transmitter in the network or a new transmitter to be introduced in the network. On selecting NEW or EXISTING transmitter, a 'help' is provided. If the selected transmitter is EXISTING one, the software would ask for the code of the transmitter. In case the complete code of the transmitter is not available, the list of all the transmitters whose code start with the same 'first' alphabet, can be called from the database. The complete code of the wanted transmitter can now be read from the list and used for further processing. In case of a NEW transmitter, the following technical parameters are required to be fed to the computer:

- TRANSMITTER CODE : Five figure code
- TRANSMITTER LOCATION
  - LONGITUDE : Degrees & minutes
  - LATTITUDE : Degrees & minutes
- HEIGHT OF TRANSMITTING ANTENNA ABOVE GROUND LEVEL : Metres
- VALUE OF HEIGHT ABOVE MEAN SEA LEVEL AT THE ANTENNA LOCATION : Metres

- CABLE AND MATCHING LOSSES : dB

- TRANSMITTER TYPE
  (FM SOUND or TV)

- TYPE OF COVERAGE REQUIRED
  (RURAL, URBAN or LARGE CITIES)

2.1.1.1.2 In addition, other technical details like frequency of operation, power, type of service (Mono or Stereo) and polarisation are also required to be fed, while determining the coverage of a FM transmitter. In case of TV transmitters, the additional information like system codes (B,G, etc.), colour standard, video and audio carrier frequency, video and audio power, band/channel, polarisation and type of frequency control are to be fed. The software can be used for the M,N,B,G,I,D,K,K1,L systems. The software can also take into account the three different types of RF frequency control systems, namely, uncontrolled, non-precision and precision control, as the protection margins in each case are different. In case of non-precision and precision frequency control systems, the frequency deviation is controlled within a limit of ±500 Hz and ±1 Hz, respectively.

2.1.1.2 Antenna Gain Pattern

2.1.1.2.1 For achieving a desired service area, the data for the antenna gain pattern is very essential. In the present software, two options are available for feeding the antenna gain pattern. The first option provides the facility to choose and retrieve an antenna gain pattern from one of the nine antenna gain patterns which are commonly in use in most of the broadcasting organisations. Thedata regarding these antenna gain patterns are available in thedatabase of the software. Under the second option, a facility hasbeen provided in the software to assign any desired antenna gain values along different radials and generate a new antenna gain pattern to suit the requirements of the service. The files thus created for an individual transmitter will automatically be considered for field strength and interference computations while executing the software. The existing antenna gain files can be edited by quantizing the antenna gain along different radials starting from 0 deg. and in incremental steps of 10 deg. to create a new data file.

2.1.1.3 Terrain Data

2.1.1.3.1 For calculating the attenuation due to terrain profile, it is essential to compute the terrain irregularity factor Δh. There are three modes in which the terrain data could be fed. In the first case, the height of terrain above mean sea level between 3 & 50 kms distances from the transmitter along different radials starting from 0 deg. and with increments of 10 deg. is fed and a data file is created. The stored data is then

analysed for distances between 3 & 15 kms and 10 & 50 kms, separately to determine the effective antenna height and terrain irregularity factor, respectively (CCIR Rec.370-5). A provision has also been made in the software to interpolate for the radials for which data is not fed/available. In the second case, if the computed data regarding the effective antenna height and the terrain irregularity factor Δh are already available then the same could directly be fed and a database can be created. Thirdly, if no details regarding terrain irregularity factor or the effective transmitting antenna height are available then the software would itself assign a default value of 50 mt for terrain irregularity factor which implies that the value of attenuation factor would be taken as zero in the computations and the default effective transmitting antenna height would be the same as the height of the transmitting antenna. The software is flexible enough to work with any of the above three options. In case the transmitter is located in proximity of sea then there is a provision to feed the data regarding the type of sea (warm or cold) and the limits where the sea starts and ends-up along a radial falling on the sea. For each individual transmitter a separate data file for the terrain irregularity, is created.

2.1.2 ANALYSIS OF THE DATA FOR COVERAGE AREA DETERMINATION

The variation of field strength with distance depends mainly on the technical parameters of the transmitter such as, the effective transmitting antenna height, effective radiated power, frequency and the terrain around the transmitter. In order to assess the coverage area of an existing transmitter or while introducing a new transmitter in the existing network, the software analyses the input data to compute the following parameters.

2.1.2.1 Terrain Irregularity Factor Δh

The terrain details between 10 & 50 km distances along different radials are used for the determination of the terrain irregularity factor Δh. This is used in computing the attenuation correction factor to be applied to the field strength in different directions.

2.1.2.2 Effective Radiated Power (E.R.P)

The effective radiated power of the transmitter is calculated by using the following formula:

$$E.R.P\ (dBK) = 10 \log P(KW) - \text{Cable \& Matching losses (dB)} + \text{Antenna gain (dB)}$$

where, P(KW) = the power of the transmitter in KW.

In case of a non-directional antenna, the E.R.P. is uniform in all the directions. However, in case of a directional antenna this value is different in different directions and the software makes use of the antenna gain information available in the relevant antenna gain pattern file related to the individual transmitter.

2.1.2.3 Effective Transmitting Antenna Height

The software computes the effective transmitting antenna height by making use of the information available in the terrain data file for distances between 3 & 15 kms. The software computes the effective transmitting antenna height along different radials. This information is utilised in calculating the field strength laid by the transmitter in different directions.

2.1.2.4 Field Strength Calculations

The field strength calculations are carried out along 36 radials starting from 0 deg. and with increments of 10 deg., with respect to true north. The computations are carried out as per the procedure given in CCIR Rec.370-5. Separate sets of curves for the VHF/UHF frequency ranges are available in this recommendation. Depending on the frequency of operation of the transmitter, the appropriate set of curve is automatically selected by the software. These curves are for 1 KW E.R.P and for different standard transmitting antenna heights for 50% of location - probability and 50%, 10%, 5% and 1% of time probability. For calculating the field strength of the wanted transmitter, the prediction curves for 50% location and 50% time probability, F(50, 50), are used. If the transmitting antenna height is different from the standard values adopted for the above curves, the software interpolates the field strength values. Appropriate correction factor is applied for taking into account the actual power of the transmitter. The terrain attenuation correction factor is taken into account wherever applicable. In cases where propagation is over mixed land and sea path, the field strength values are calculated using the method described in CCIR Rep.239-7. The coverage area of the transmitter is worked out with the help of F(50, 50) curves by taking into account the minimum usable field strength applicable for the type of service under consideration.

2.1.2.5 Interference Computation

For the computation of interference to the field of the wanted transmitter, the simplified multiplication method explained in Annex-I of CCIR Report 945-2 has been adopted. The transmitters operating within a radial distance of 800 kms around the wanted transmitter and having a frequency of operation within $\pm$400 kHz with respect to the frequency of the wanted transmitter, would be considered by the software for the interference calculation, in the case of FM operations. It also takes into

account transmitters operating at a frequency ±10.5 to 10.9 MHz and the software determines the interference which is dominant. In the case of TV broadcast services, the transmitters operating on co-channel and adjacent channels within a radial distance of 800 kms from the wanted transmitter, are taken into account. The software can also be used for assessing the interference of any one of the transmitter operating in the network over the other transmitters. This facility is very useful while introducing a new transmitter in an existing network of transmitters. By simulating interference conditions caused by different transmitters at the location where a new transmitter is proposed to be installed, the best possible technical parameters for the proposed new transmitter could be worked out for getting an optimum service. The limiting distance of 800 kms for interference calculations can be modified to any desired distance depending on the requirements of the network.

2.1.3 PRESENTATION OF RESULTS

The intermediate and final results of the analysis can be presented in two forms:

- Tabular statements;
- Graphic display.

2.1.3.1 Tabular statements

The results of analysis for the following parameters can be presented in tabular form:

- Variation of field strength with distance;
- Effective Antenna height, Δh and antenna gain on each radial;
- Antenna gain pattern;
- Terrain data analysis.

2.1.3.2 Graphical presentation

The following parameters can be presented in graphical form:

- Antenna gain pattern;
- Terrain irregularity factor;
- Effective transmitting antenna height;
- Coverage of a transmitter considering the usable field strength and antenna gain pattern;
- Effect of interference on the coverage area of a wanted transmitter.

2.1.4 SPECIAL FEATURES OF THE SOFTWARE

The software developed for the planning of VHF/UHF services has a number of special features which are enumerated below:

- the program has been developed in 'C' language and is compatible with PC-XT/AT or any other IBM/PC system;

- various database files are automatically created once a transmitter is assigned its code. The data entry is menu driven and the data is automatically stored in the respective files;

- the coverage area of a transmitter can be graphically displayed on the monitor. The field strength laid by a transmitter at any desired location inside the coverage area can be obtained with the help of a moving 'arrow' marker. It is also possible to change the scale of coverage pattern so as to enable the planner to compress or expand the presentation on the screen for studying finer details. Interference protected coverage can also be displayed on the same screen. This helps in assessing the shrinkage of the coverage due to interference;

- the CCIR field strength prediction curves can be displayed on the screen. The field strength for any desired distance can be directly computed from these curves. For each set of field strength curves, the value of field strength for a particular distance shall be displayed on the screen for each standard antenna height corresponding to each curve;

- the CCIR curves for the attenuation correction factor as a function of the distance (km) and terrain irregularity factors, can also be displayed on the screen;

- the software has the flexibility to rotate antenna gain pattern to simulate different conditions to study the effect of antenna directivity, while planning a new service.

CHAPTER III

INSTALLATION OF THE SOFTWARE

3.1 OPERATING ENVIRONMENT

3.1.1 Hardware Requirement

3.1.1.1 The software can work on any IBM compatible system, preferably PC-XT/AT and CGA monitor. The software package needs a minimum configuration of 2 MB RAM and 20 MB hard disk. At least 5 MB hard disk memory space is needed to work comfortably with the system.

3.1.2 Software

3.1.2.1 The program has been written in 'C' language. The system works on MS-DOS system version 3.0 and above. The entire software is menu driven and easy to operate. The complete software is available on 4 number of 360 KB diskettes of 5-1/4 inch size. The entire software consist of 24 modules and the main module is PLANTVFM. The list of the various modules is available at Annex-V. A number of data files are also required to be created for each transmitter. A list of these data files is available at Annex-VI.

3.2 INSTALLATION OF THE PROGRAM

3.2.1 After booting the system, the following steps are required to be followed to install the program:

STEP 1: After the booting of the system, C:\> would appear on the screen. Insert the Floppy # 01 in drive A. Type A:, A:\> would appear on the screen.

STEP 2: Type INSTALL C:
The system automatically creates PLANTVFM Directory in C: and installs PLANTVFM program. On the screen the following message appears:

Creating Directory PLANTVFM.....

WAIT A WHILE AS THE INSTALLATION IS IN PROGRESS

Once Floppy # 01 is installed, replace it by Floppy #02 in drive A: and press ENTER key to continue. In this process all the four floppies are installed in C:. Fol

PLANTVFM SYSTEM SUCCESSFULLY INSTALLED.....

Type PLANTVFM to run the system.

HAPPY BROADCAST PLANNING!!!!!....

The system is now ready for use. Press ENTER key to proceed further. Following will appear on the screen:

C:\PLANTVFM>

Type PLANTVFM, then the program **LOGO** would appear. Press ENTER key again. The main menu would appear. The planner then has to refer to Chapter IV on Operations Manual for running the program further.

CHAPTER IV

OPERATIONS MANUAL

4.0 OPERATING PROCEDURE

4.1 GENERAL

The planning software PLANTVFM is menu driven and 'help' facility has been provided at a number of places to guide the planner in running the program. Besides, wherever needed, specific instructions required for the smooth running of the program, also appear on the screen.

4.2 SELECTION OF MENU

Once the software is installed, the program 'LOGO' appears on the screen. Press ENTER key, the Main Menu would appear on the screen. It consists of five distinct sections.

- SELECT
- DATA
- TABULATE
- GRAPHICS
- INTERFERENCE

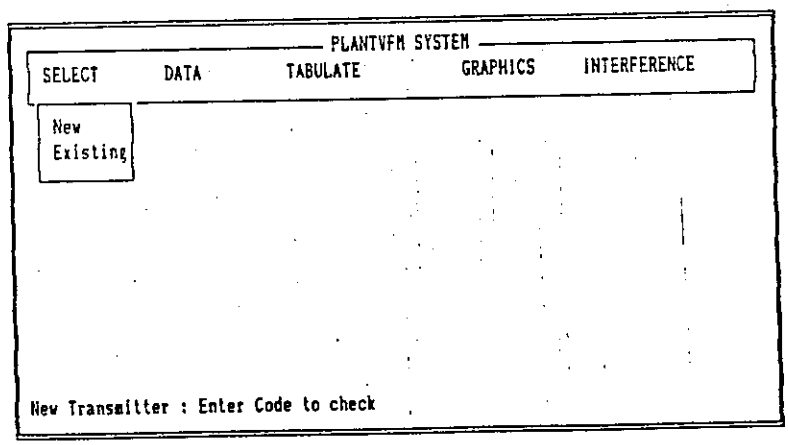
The requirements/functions of each one of the five sections of the Main Menu are as follows:

4.2.1 SELECT

4.2.1.1 A transmitter is selected by entering to the 'SELECT' menu. This menu has two options:

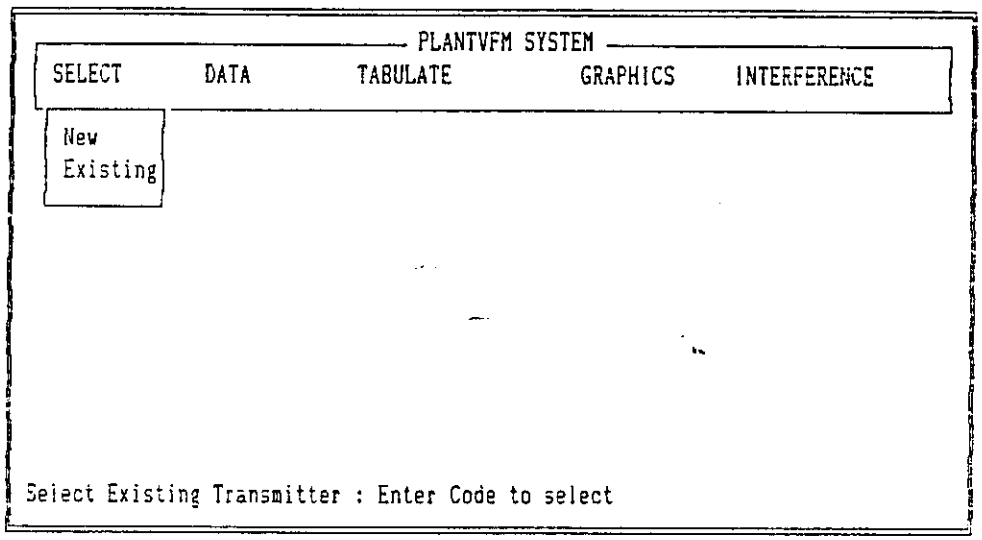
- NEW
- EXISTING

A new transmitter for which data is not already available in the database, is selected by opting 'NEW'. On selection of option 'NEW' and pressing of ENTER key, the following appears on the screen:

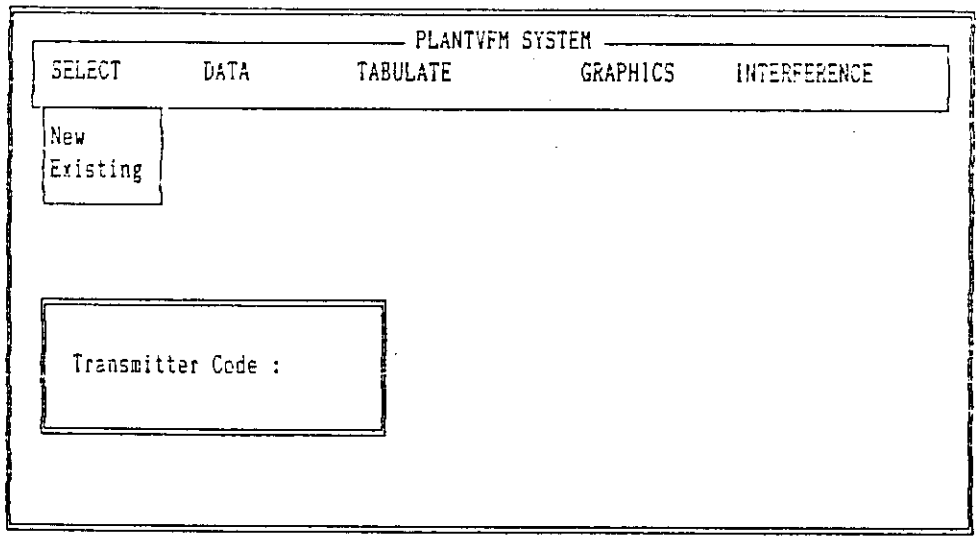


At this stage, the program demands the 'transmitter code' as input to continue further. The transmitter code comprises of three alphabets and two numeric characters. The remaining procedure for feeding/retrieving data etc. is common for both NEW and EXISTING options.

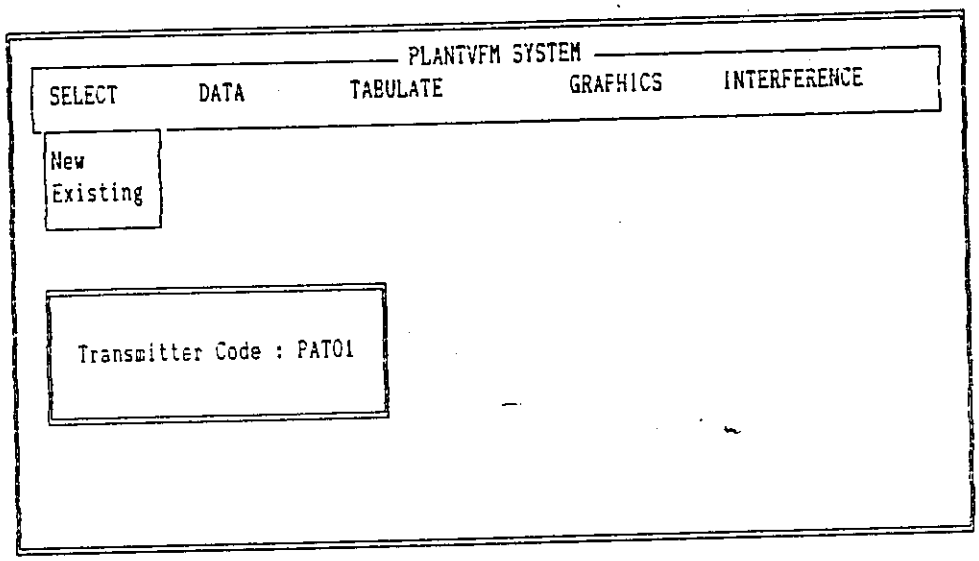
4.2.1.2 The selection of the EXISTING option helps in selecting any one of the transmitters for which data is already available in the database. After pressing of SELECT key, the following appears on the screen:



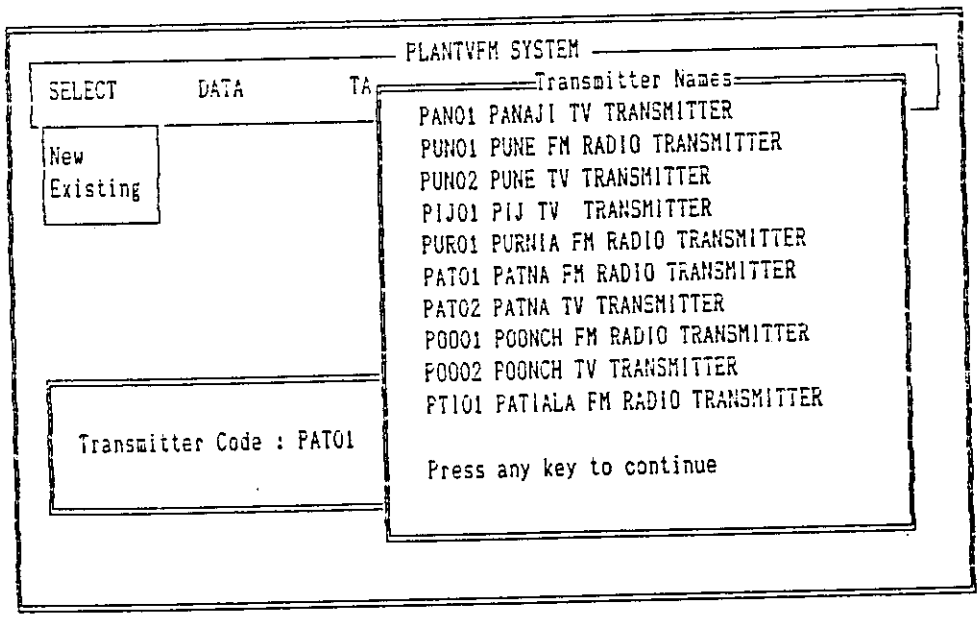
Press the ENTER key once again and the following appears on the screen:



At this stage the code of the wanted transmitter is to be fed (e.g.,PAT01). If the transmitter code is not known, the software has the facility to call all the existing transmitters by the first letter of the transmitter code (e.g.,P). The computer would then display all the transmitters whose code starts with the character 'P'.



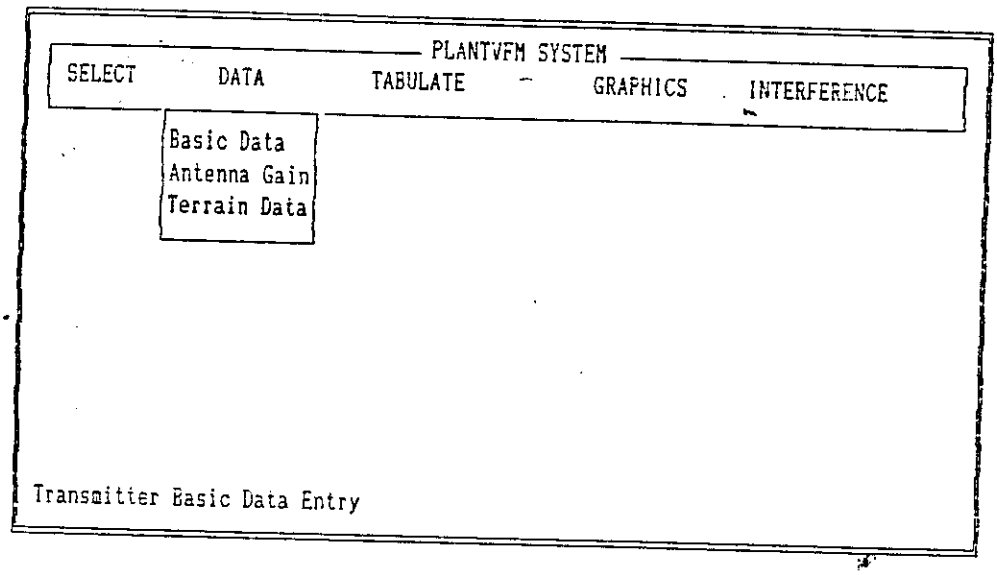
The planner can then select the code of the desired transmitter from the list.



4.2.1.3 Once a transmitter is selected, all the relevant data files corresponding to this transmitter would automatically be addressed to. In case of a NEW transmitter, once the code for the transmitter is assigned, all the relevant files would automatically be opened and any data entered hereafter would go to their respective files.

4.2.2 DATA

4.2.2.1 After the selection of the transmitter, the relevant data can be retrieved/entered by choosing the 'DATA' menu. If an existing transmitter is choosen, the data of the transmitter can be retrieved and edited, if so desired. In case of a new transmitter, the relevant data is required to be fed at this stage. Once data menu is selected, the following appears on the screen:



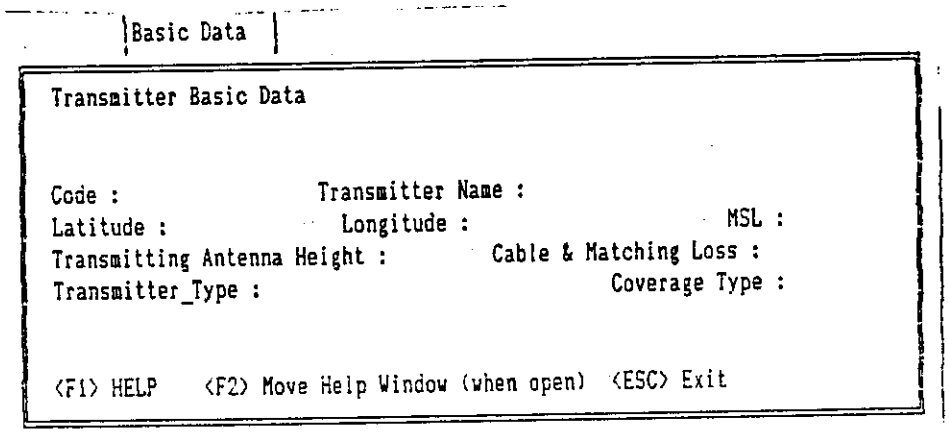
The data menu consist of three sub-sections:

- Basic Data
- Antenna Gain
- Terrain Data

4.2.2.1.1 Basic Data

The Basic Data comprises of mainly the geographical location of the transmitter, transmitting antenna height, cable

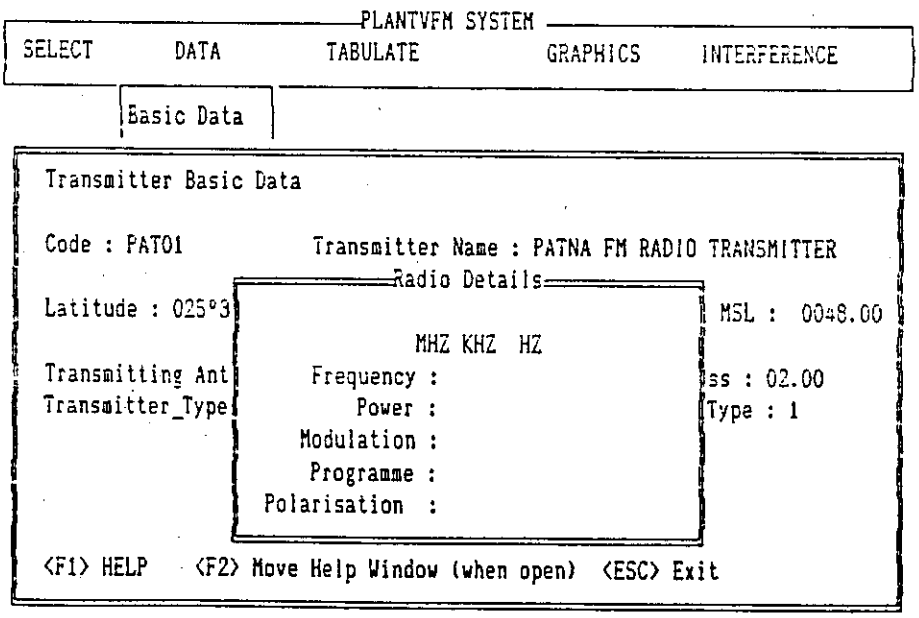
and matching losses, coverage type, etc. The following screen represents the Basic Data requirements:



The entries required to be made at this stage are common to both FM Sound Broadcasting and TV services. However, the format for feeding the technical parameters of the transmitter for FM sound broadcasting and TV broadcasting services are different, to match with the technical requirements of the two services.

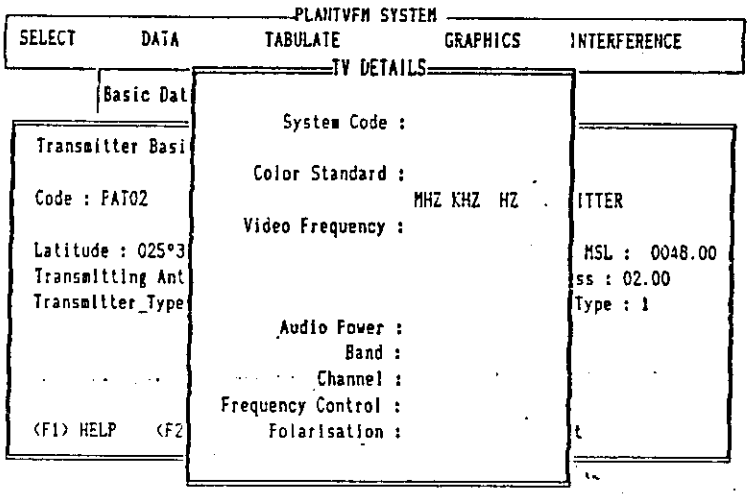
- **FM broadcast transmitter data**

In case of FM broadcast service the following screen will appear on the previous screen, in 'inset', for entering the technical parameters of the transmitter. The format of the screen would be as follows:



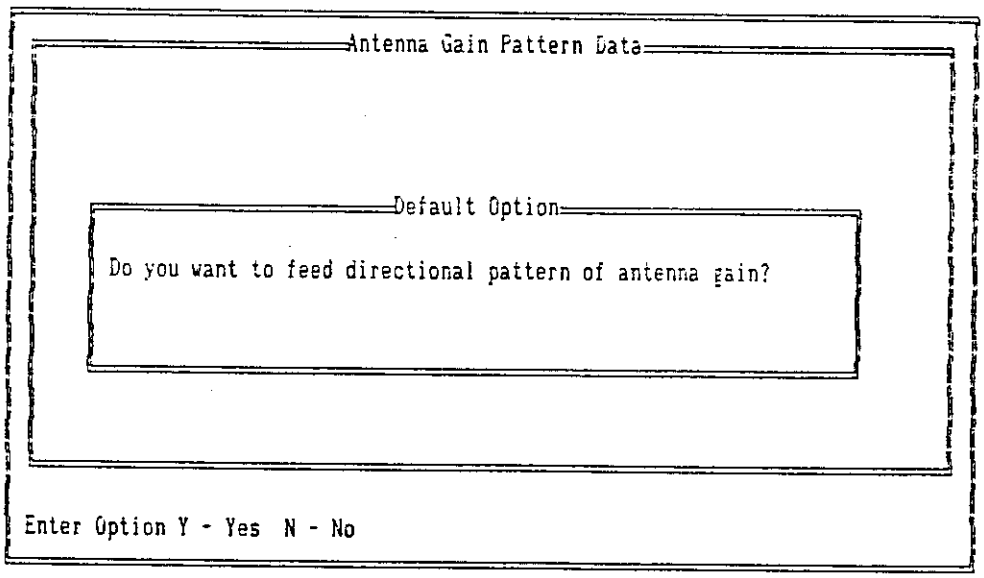
- TV transmitter data

If the transmitter selected is for TV service, a different format would appear on the screen in 'inset'. The screen would appear as follows:



4.2.2.2.2 Antenna Gain Pattern

4.3.5.1 On selecting 'Antenna Gain' menu, the following appears on the screen:

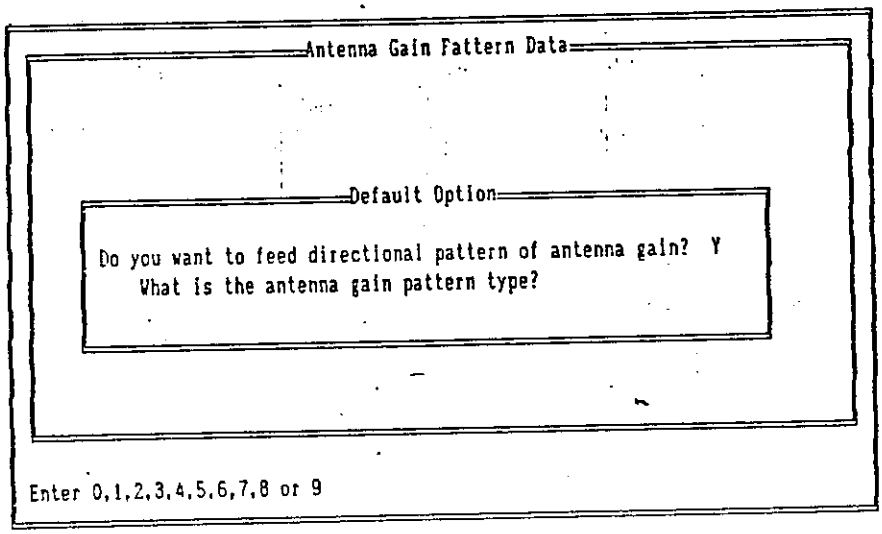


The data regarding Antenna Gain Pattern can be entered in the following two fashions:

- SELECTION FROM EXISTING GAIN PATTERNS
- ENTRY OF DEFAULT VALUES

- Selection from existing gain patterns

After entering into this routine, 'Antenna Gain Pattern' can be selected from one of the nine antenna patterns available in the data file by selecting the codes from 1 to 9. These nine antenna patterns represent the commonly used patterns. An additional position '0' has been provided for storing any new antenna pattern in the data file. The screen would appear as follows:

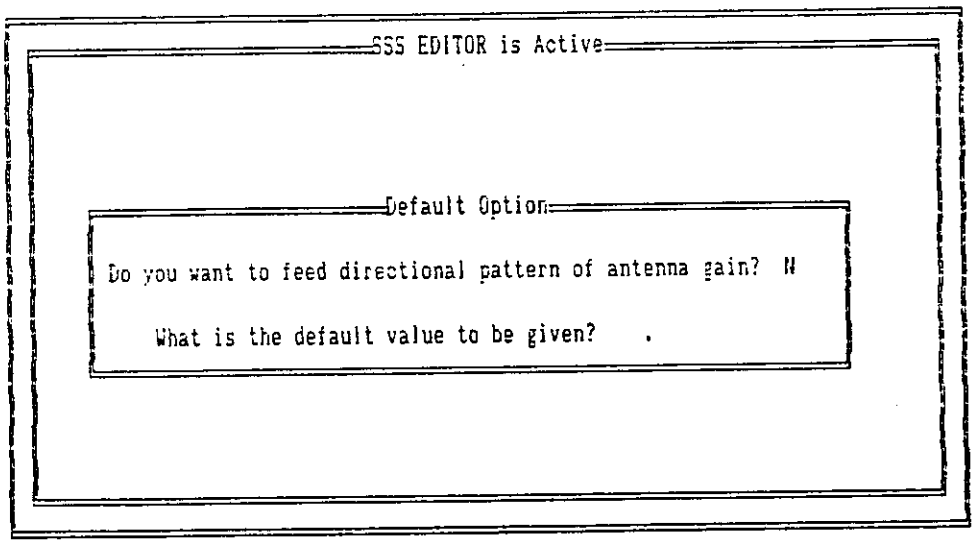


allow choice of ant type 1 to 9

By entering 'Y', the format for entering the antenna code will appear. Depending on the requirement, the relevant code number can be entered. The corresponding antenna pattern file would then automatically be addressed to.

- Entry of default value

In case 'N' is entered into the format, the following will appear:

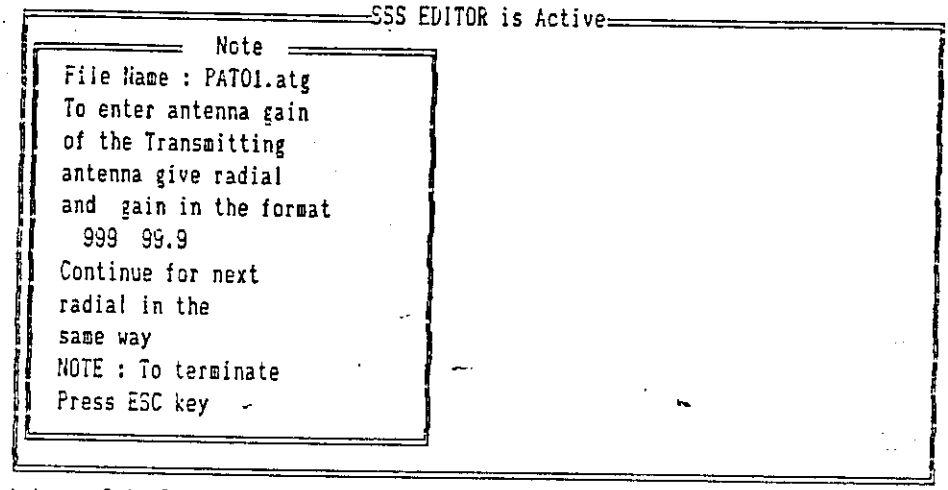


Delete .sty file in DOS to start again. (Alternatively, just edit the antenna file accordingly).

The program will ask for the option for default value for the antenna gain. If a gain-value is entered at this stage, an omnidirectional antenna gain pattern is selected corresponding to the gain-value.

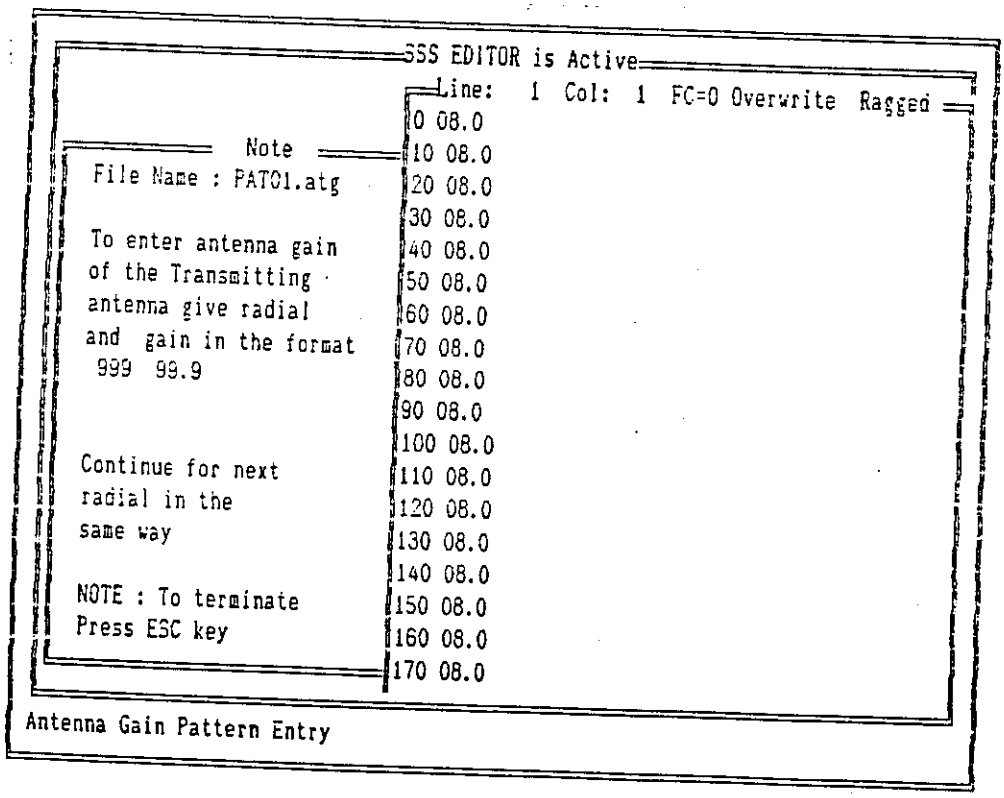
- *Editing of antenna gain pattern*

The planner may select entry option in which support of the editor is provided to feed/modify the data as required.



Antenna Gain Pattern Entry

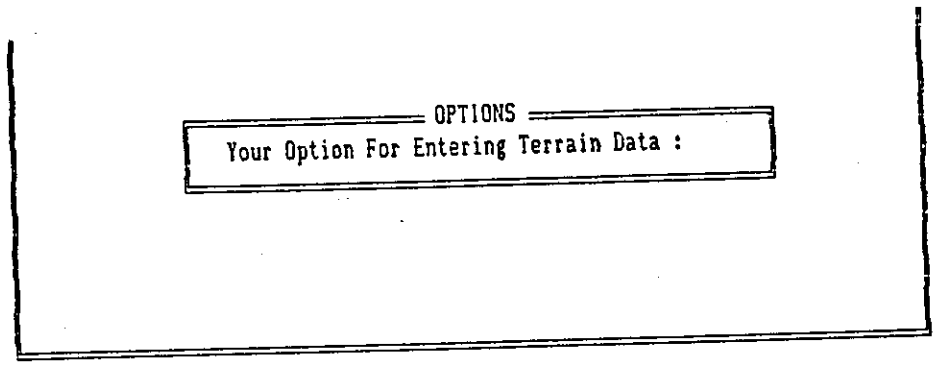
Following this the editor support appears and the planner is free to modify the data as required and save the data for further processing.



Antenna Gain Pattern Entry

4.2.2.2.3 Terrain Data

By selecting the 'Terrain Data' menu, the following appears on the screen:

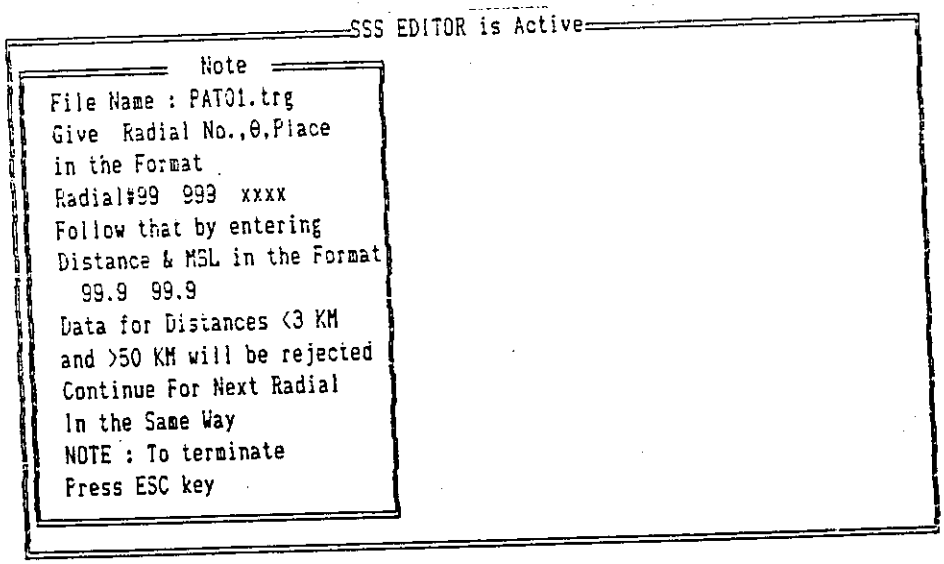


Three options have been provided in the software for entering the Terrain Data:

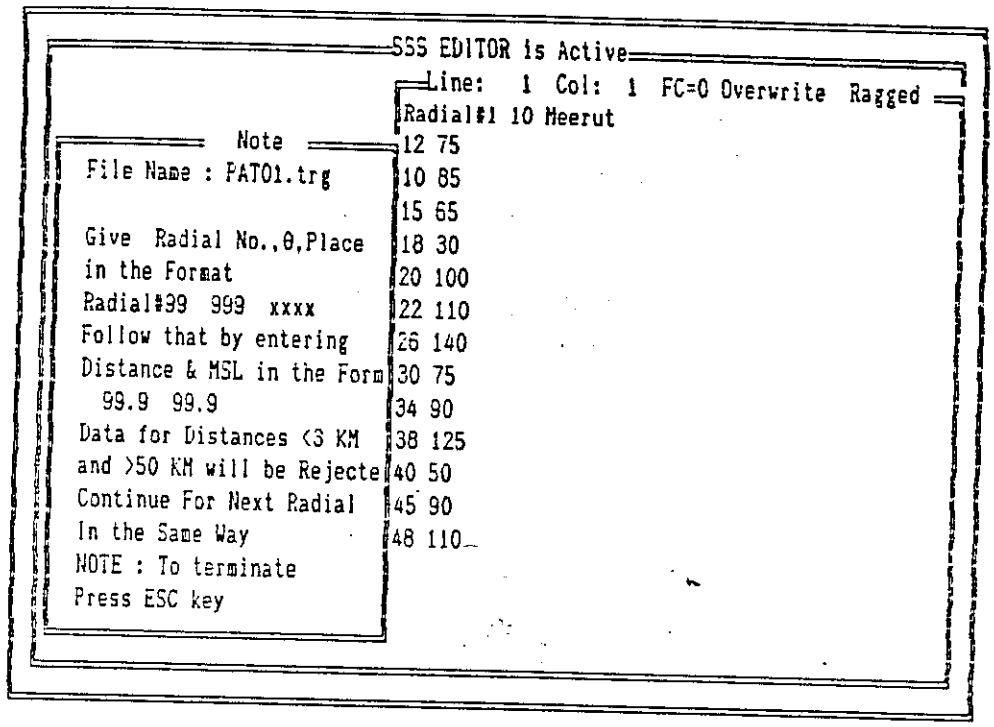
- Entering actual terrain data
- Entering Δh values
- Selecting the default parameter

- Actual Terrain Data

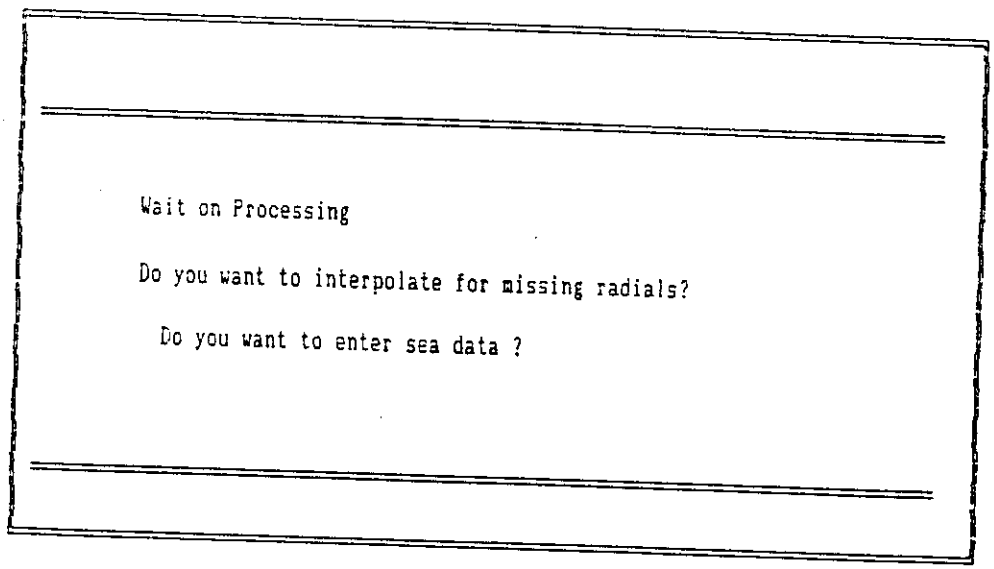
On selecting this option, the planner has to first enter the radial number, radial angle and the 'location' on this radial. This is followed by the data regarding distance and MSL. The data is entered for distances from 3 to 50 kms, in any order. The software arranges the data in increasing order while computing. The screen appears as follows:



In case the existing data is to be modified, the editor's support is called on the screen. The data can now be viewed on the screen and modified, as desired.



The Δh values and the effective antenna height are then computed. The software has the option to interpolate these values along the radials for which terrain data is not entered/available. Default values are taken into account if this option is not used. For the interpolation of missing radials the following appears on the screen:



If sea appears along a radial, then the following sea data is required to be entered:

- Radial,
- Type of sea,
- Distance at which sea starts,
- Distance where the sea ends.

When the planner enters 360 for the radial, the other values entered after that are ignored and it marks the end of the sea data entry.

Note

File Name : PAT01.dhc
The values shown are :
Radial,
Sh value,
Eff. Antenna Ht.,
Type of landscape -l(and)
c(old)or w(arm) sea,
start of sea,
end of sea
NOTE : To terminate
Press ESC key

For viewing the sea data, the following appears on the screen:

SSS EDITOR is Active

Line: 1 Col: 1 FC=0 Overwrite Ragged

Note

File Name : PAT01.dhc

The values shown are:
Radial,
Sh value,
Eff. Antenna Ht.,
Type of landscape -l(and)
c(old) or w(arm) sea,
start of sea,
end of sea

NOTE : To terminate
Press ESC key

0.0	50.0	150.0	1	0.0	0.0
10.0	54.5	122.0	1	0.0	0.0
20.0	50.0	150.0	1	0.0	0.0
30.0	53.0	127.5	1	0.0	0.0
40.0	50.0	150.0	1	0.0	0.0
50.0	53.0	127.5	1	0.0	0.0
60.0	50.0	150.0	1	0.0	0.0
70.0	53.0	127.5	1	0.0	0.0
80.0	50.0	150.0	1	0.0	0.0
90.0	50.0	150.0	1	0.0	0.0
100.0	53.0	127.5	1	0.0	0.0
110.0	68.0	122.5	1	0.0	0.0
120.0	53.0	127.5	1	0.0	0.0
130.0	53.0	127.5	1	0.0	0.0
140.0	53.0	127.5	1	0.0	0.0
150.0	62.1	120.0	1	0.0	0.0

- **Entering Δh values**

Under this option, the planner has to enter the Δh values directly, instead of computing them from the terrain data. The details to be entered are:

- Radial
- Δh value
- Effective antenna height (ESS. A.H.)
- Type of landscape
- Distance at which the sea starts
- Distance at which the sea ends

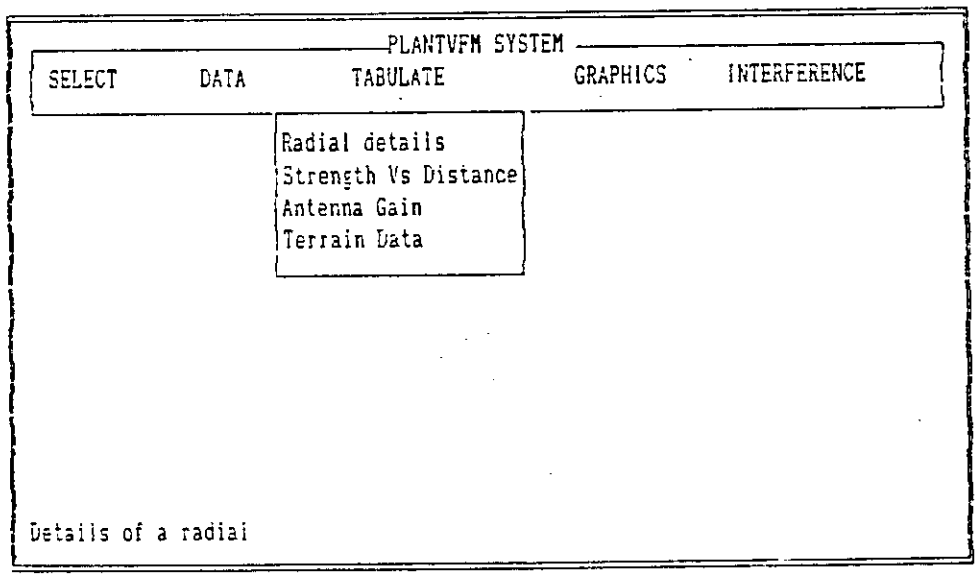
- **Selecting the Default Parameter**

This option creates a Δh file with the default values. This file can be edited by using the above option.

NOTE: Only Option 1 will create the Δh value by erasing the existing file, if any.

4.2.3 TABULATION OF RESULTS

On selection of 'TABULATE' menu, the following appears on the screen:



The 'TABULATE' menu has four sub-menu:

- Radial details
- Field Strength Vs Distance
- Antenna Gain (Ant. 5)
- Terrain Data

4.2.3.1 Radial details

On selecting the sub-menu 'radial details', the following appears on the screen:

Transmitter : PATNA FM RADIO Frequency : 102,500,000Power :003.00

Radial	Eff.A.H	del h	at. g	c.l.	distance	Elh	Euh	Ei	dh corr.	Ew
20	127.5	53.0	11.0	2.0	10.0	70.5	78.0	75.8	0.0	89.5
					20.0	56.0	63.5	61.2	0.1	75.1
					30.0	46.5	54.5	52.1	0.2	66.0
					40.0	41.0	48.5	46.2	0.2	60.2
					50.0	36.0	42.5	40.5	0.3	54.6
					60.0	31.5	38.5	36.4	0.3	50.5
					70.0	27.5	34.0	32.0	0.3	46.1
					80.0	24.5	30.0	28.4	0.3	42.4
					90.0	21.5	27.0	25.4	0.3	39.4
					100.0	19.5	24.0	22.6	0.3	36.7

The planner can view the field strength details along any desired radial by selecting the proper radial angle/number.

4.2.3.2 Field Strength Vs Distance

In selection of this menu, the following screen appears:

Transmitter : PATNA FM RADIO TRANSMITTER Power : 000.10

Strength in db asked for : 45.0

Radial	Distance	Radial	Distance
0.0	34.1	180.0	38.2
10.0	33.9	190.0	38.0
20.0	34.1	200.0	37.8
30.0	34.3	210.0	37.5
40.0	34.6	220.0	37.3
50.0	34.8	230.0	37.1
-----	----	-----	----
160.0	32.8	340.0	34.6
170.0	38.4	350.0	34.4

where

c.l. : cable loss

E_{lh}, E_{uh} : values of field strength corresponding to curves from Rec 370 for eff. ant. hts below and above actual eff ant ht.

E_i : interpolated value of field strength for the actual eff. ant. ht.

($E_i = E_i$ + Ant corr − c.l. − Δh corr)

The field strength at any desired location can also be viewed directly on the screen.

4.2.3.3 Antenna Gain

On the selection of 'Antenna Gain' menu, the details of the antenna gain along different radials as a function of distance appears on the screen. The details of the screen is given below:

Antenna Gain Pattern

Radial	Antenna Gain	Radial	Antenna Gain
0.0	11.0	180.0	11.0
10.0	11.0	190.0	11.0
20.0	11.0	200.0	11.0
30.0	11.0	210.0	11.0
40.0	11.0	220.0	11.0
50.0	11.0	230.0	11.0
-----	----	-----	-----
160.0	11.0	340.0	11.0
170.0	11.0	350.0	11.0

4.2.3.4 Terrain Data

The details of the terrain data can be displayed on the screen by the selection of 'Terrain Data' menu. The screen would appear as follows:

Terrain particulars

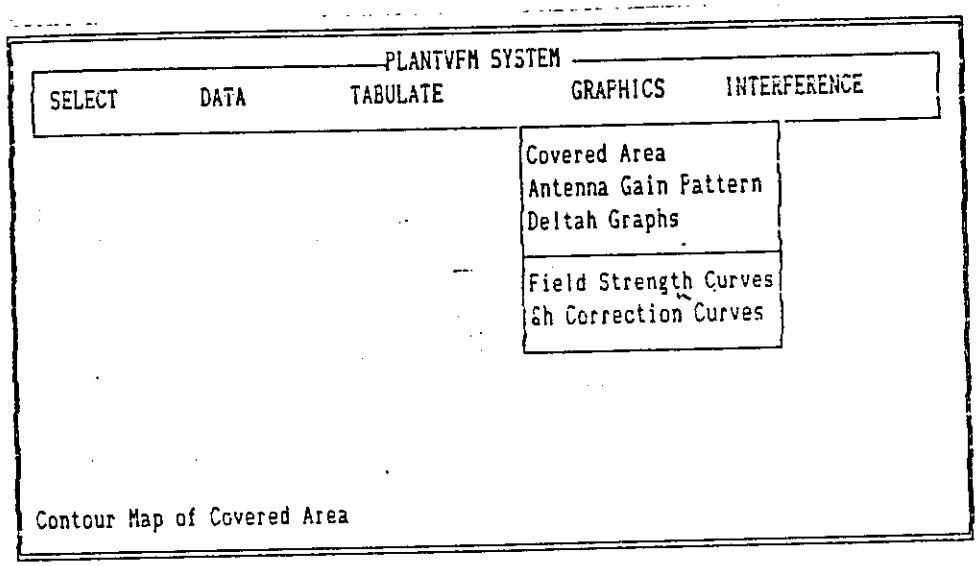
Radial	Sh	Eff. h	Type	Sea Start	Sea End	Radial	Sh	Eff. h	Type	Sea Start	Sea End
0.0	50.0	150.0	l	0.0	0.0	180.0	50.0	150.0	l	0.0	0.0
10.0	54.5	122.0	c	95.0	800.0	190.0	50.0	150.0	l	0.0	0.0
20.0	53.0	127.5	l	0.0	0.0	200.0	50.0	150.0	l	0.0	0.0
30.0	68.0	122.5	l	0.0	0.0	210.0	50.0	150.0	l	0.0	0.0
40.0	62.1	120.0	l	0.0	0.0	220.0	50.0	150.0	l	0.0	0.0
50.0	57.0	150.0	l	0.0	0.0	230.0	50.0	150.0	l	0.0	0.0
----	----	-----	-	---	---	-----	----	-----	-	----	---
160.0	50.0	150.0	l	0.0	0.0	340.0	50.0	150.0	l	0.0	0.0
170.0	50.0	150.0	l	0.0	0.0	350.0	57.0	150.0	l	0.0	0.0

4.2.4 GRAPHICS

4.2.4.1 The 'GRAPHICS' menu helps in viewing the graphical presentation of the following results:

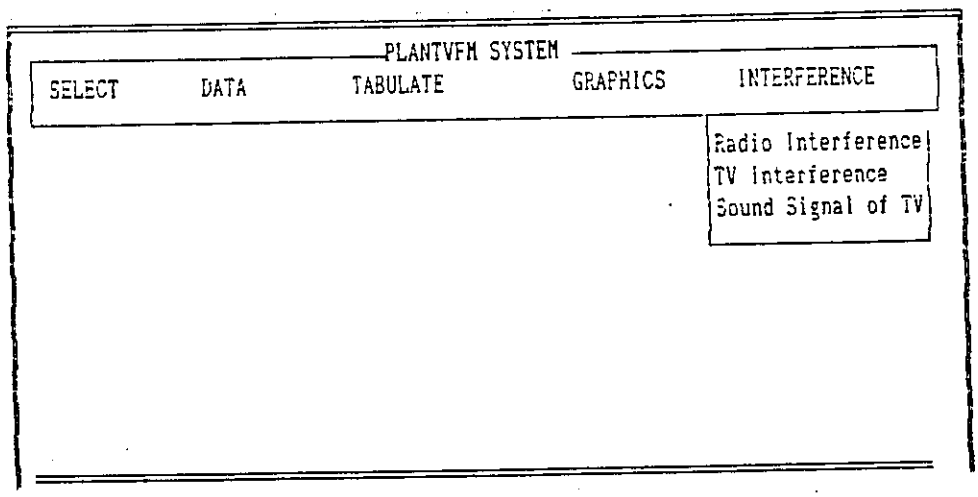
- Antenna Gain Pattern;
- Δh graph;
- Terrain Irregularity correction curves;
- Coverage area;
- Field Strength Prediction Curves (CCIR Rec.370-5).

The screen would appear as follows:



4.2.5 INTERFERENCE

The selection of 'INTERFERENCE' menu provides the following on the screen:



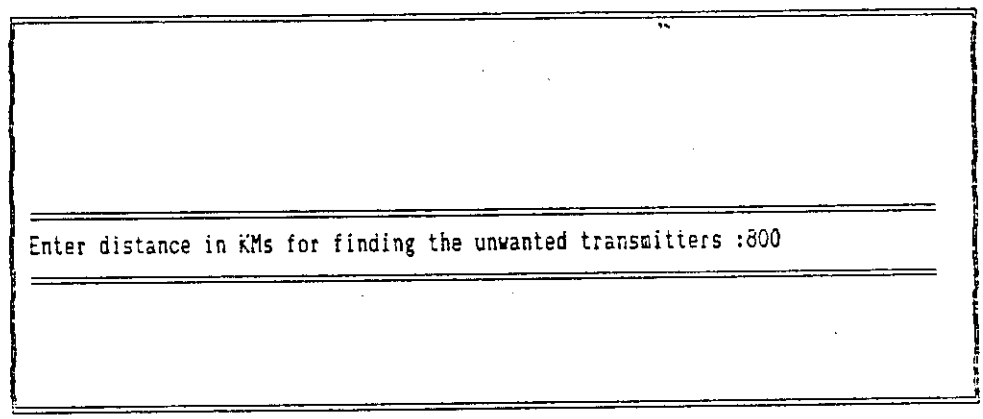
Interference to the service of the wanted transmitter from other unwanted transmitters is computed as per the procedure discussed in Chapter I. The following three types of interference are possible:

- INTERFERENCE TO FM SOUND BROADCAST (RADIO) SERVICE
- INTERFERENCE TO THE VIDEO CARRIER OF TV SERVICE
- INTERFERENCE TO THE SOUND CARRIER OF TV SERVICE

The coverage area without interference and in the presence of interference can be displayed directly on the screen to know the extent of the shrinkage of the coverage area.

4.2.5.1 Interference to FM Sound Broadcast (Radio) Service

For computing the subsequently of interference to the FM broadcast transmitter, the unwanted transmitters lying within the specified limits of distance, and frequency, are identified. The limiting distance can be changed from the pre-selected value of 800 km to any other value, if desired. The screen would appear as follows:



On entering the desired limit of distance, the unwanted transmitters are identified by the software and displayed on the screen:

RADIO TRANSMITTERS WITHIN 800 KM OF PATNA FM RADIO TRANSMITTER

TRANSMITTER	FREQUENCY	DISTANCE	E.R.P.
TESTI FM RADIO TRANSMITTER	091,600,000	100.23	30.42
BELONIA FM RADIO TRANSMITTER	103,700,000	676.33	30.92
BILASPUR FM RADIO TRANSMITTER	103,700,000	493.74	30.92
BALAGHAT FM RADIO TRANSMITTER	102,900,000	659.87	30.92
BOLANGIR FM RADIO TRANSMITTER	101,900,000	569.22	30.92
BAREILLEY FM RADIO TRANSMITTER	102,100,000	644.53	30.42

Press any key to continue

Following this, the list of TV transmitters within the desired limit also appears on the screen:

TV TRANSMITTERS WITHIN 600 KM OF PATNA FM RADIO TRANSMITTER

TRANSMITTER	FREQUENCY	DISTANCE	E.R.P.
TEST TV TRANSMITTER	203,250,000	100.23	35.53
TEST TV TRANSMITTER	217,250,000	100.23	35.53
TEST TV TRANSMITTER	206,250,000	100.23	35.53
TEST TV TRANSMITTER	211,500,000	100.23	35.53
TEST TV TRANSMITTER	211,250,000	100.23	35.53
CUTTACK TV TRANSMITTER	196,250,000	571.00	36.03
DALTONGANJ TV TRANSMITTE	189,250,000	202.41	36.03

Next the transmitters which offer the highest order constraints within the specified limits of the frequency of the wanted transmitter are listed:

(± 10.5 to 10.9 MHz)

HIGHEST ORDER CONSTRAINT

UNWANTED TRANSMITTER	FREQUENCY	DISTANCE	E.R.P.	TYPE OF CONSTRAINT
TEST1 FM RADIO TRANSMITTER	091,600,000	100.00	30.42	- 10.7 ± 0.2 MHz
TEST2 FM RADIO TRANSMITTER	091,700,000	18.00	30.92	- 10.7 ± 0.1 MHz
TEST3 FM RADIO TRANSMITTER	091,800,000	149.00	31.92	- 10.7 ± 0.1 MHz
TEST4 FM RADIO TRANSMITTER	091,900,000	24.00	30.92	- 10.7 ± 0.1 MHz
TEST5 FM RADIO TRANSMITTER	092,000,000	149.00	31.92	- 10.7 ± 0.2 MHz
TEST6 FM RADIO TRANSMITTER	113,000,000	24.00	30.92	+ 10.7 ± 0.2 MHz
TEST7 FM RADIO TRANSMITTER	113,100,000	149.00	31.92	+ 10.7 ± 0.1 MHz
TEST8 FM RADIO TRANSMITTER	113,200,000	24.00	30.92	+ 10.7 ± 0.1 MHz
TEST9 FM RADIO TRANSMITTER	113,300,000	149.00	31.92	+ 10.7 ± 0.1 MHz
TEST10 FM RADIO TRANSMITTER	113,400,000	24.00	30.92	+ 10.7 ± 0.2 MHz

Press Any Key to Continue

Wanted TX freq. = 102.5 MHz, presumably

Then the transmitters which interfere with the wanted transmitter are listed:

↘ ± 400 kHz

Wanted TX freq 102.5 MHz

TRANSMITTERS WITHIN ± 400 KHz of PATNA FM RADIO TRANSMITTER

UNWANTED TRANSMITTER	FREQUENCY	DISTANCE	E.R.P.
BALAGHAT FM RADIO TRANSMITTER	102,900,000	659.00	30.92
BAREILLEY FM RADIO TRANSMITTER	102,100,000	644.00	30.42
BARIPADA FM RADIO TRANSMITTER	102,900,000	606.00	30.92
FAIZABAD FM RADIO TRANSMITTER	102,300,000	331.00	30.92
HAZARIBAGH FM RADIO TRANSMITTE	102,100,000	182.00	30.92
ROURKELA FM RADIO TRANSMITTER	102,600,000	373.00	30.92
RAIGARH FM RADIO TRANSMITTER	102,700,000	448.00	30.92
SHIVPURI FM RADIO TRANSMITTER	102,100,000	752.00	30.92

Press Any Key to Continue

The interfering TV transmitters are also identified:

TV TRANSMITTERS INTERFERING PATNA FM RADIO TRANSMITTER

UNWANTED TRANSMITTER	FREQUENCY	DISTANCE	E.R.P.
SILCHAR TV TRANSMITTER	103,300,000	759.00	30.42

Press Any Key to Continue

After identifying the interfering transmitters, the interference values both for Steady State and Tropospheric interference are calculated for finding out the protection ratios. The appropriate protection ratios are then choosen and Esi value is calculated. The screen appears as follows:

Checking for steady state/Tropospheric interference
Enter the Time Probability of Coverage Required : 90

UNWANTED TRANSMITTER	E(50,50)	E(50,10)	As	At	Esi	Type
BALAGHAT FM RADIO TRANSMITTER	-38.22	-31.11	-20.00	-20.00	-37.31	Tropo
BAREILLEY FM RADIO TRANSMITTE	-37.02	-29.81	-20.00	-20.00	-36.01	Tropo
BARIPADA FM RADIO TRANSMITTER	-33.98	-26.52	-20.00	-20.00	-32.72	Tropo
FAIZABAD FM RADIO TRANSMITTER	-10.79	-1.47	7.00	7.00	19.33	Tropo
HAZARIBAGH FM RADIO TRANSMITT	5.43	16.19	-20.00	-20.00	9.99	Tropo
PURNIA FM RADIO TRANSMITTER	-0.85	9.59	7.00	7.00	30.39	Tropo
ROURKELA FM RADIO TRANSMITTER	-15.68	-6.91	33.00	25.00	31.89	Tropo
RAIGARH FM RADIO TRANSMITTER	-20.84	-12.98	7.00	7.00	7.82	Tropo
SHIVPURI FM RADIO TRANSMITTER	-45.75	-39.26	-20.00	-20.00	-45.46	Tropo
SILCHAR TV TRANSMITTER	-45.10	-39.01	22.00	12.00	-3.22	Steady

Press Any Key to Continue

Esi minimum field from i th TX

"Choice" of propagation mode in final column will correspond to the larger of :-

i) $E(50,50) + A_s$, or

ii) $E(50,10)$ or $E(50,1) + A_t$

TV TRANSMITTERS WITHIN 800 KM OF PATNA TV TRANSMITTER

TRANSMITTER	FREQUENCY	DISTANCE	E.R.P.
TEST TV TRANSMITTER	203,250,000	100.23	35.53
TEST TV TRANSMITTER	217,250,000	100.23	35.53
TEST TV TRANSMITTER	206,250,000	100.23	35.53
TEST TV TRANSMITTER	211,500,000	100.23	35.53
TEST TV TRANSMITTER	211,250,000	100.23	35.53
TEST TV TRANSMITTER	205,000,000	100.23	35.53
TEST TV TRANSMITTER	211,750,000	100.23	35.53
AGARTALLA TV TRANSMITTER	196,250,000	646.27	36.03
CALCUTTA TV TRANSMITTER	182,250,000	472.02	37.03
CUTTACK TV TRANSMITTER	196,250,000	571.00	36.03
DALTONGANJ TV TRANSMITTE	189,250,000	202.41	36.03

From the Esi values, the Usable Field Strength is computed. The appropriate interference curves are then drawn depending on Eu values.

4.2.5.2 Interference to Video Carrier of TV Service

As in the above case, the interfering transmitters within a specified distance are first identified and listed:

TV TRANSMITTERS WITHIN 800 KM OF PATNA TV TRANSMITTER

TRANSMITTER	FREQUENCY	DISTANCE	E.R.P.
TEST TV TRANSMITTER	203,250,000	100.23	35.53
TEST TV TRANSMITTER	217,250,000	100.23	35.53
TEST TV TRANSMITTER	206,250,000	100.23	35.53
TEST TV TRANSMITTER	211,500,000	100.23	35.53
TEST TV TRANSMITTER	211,250,000	100.23	35.53
TEST TV TRANSMITTER	205,000,000	100.23	35.53
TEST TV TRANSMITTER	211,750,000	100.23	35.53
AGARTALLA TV TRANSMITTER	196,250,000	646.27	36.03
CALCUTTA TV TRANSMITTER	182,250,000	472.02	37.03
CUTTACK TV TRANSMITTER	196,250,000	571.00	36.03
DALTONGANJ TV TRANSMITTE	189,250,000	202.41	36.03

The interference is then computed in the same manner as in the case of sound transmissions.

4.2.5.3 Interference to Sound Carrier of TV Service

In this case also all the interfering transmitters within the specified range are identified and listed. Appropriate protection ratios are choosen and Esi values are computed to obtain the usable field strength (Eu).

CHAPTER V

CONCLUSION

5.1 Conclusion

5.1.1 The PLANTVFM software package is very powerful and comprehensive, incorporating all relevant CCIR Reports and Recommendations. The package is extremely useful in determining FM and TV transmitter coverages, both in the presence of interference and without any interference. The system has been developed to assist the planner to evaluate coverage area of existing transmitters in the network and to protect the coverage of a planned transmitter, likely to be introduced in the network.It also helps in optimising the coverage area of each transmitter in the network, taking into account the geographic location, terrain around it and actual technical parameters into consideration.

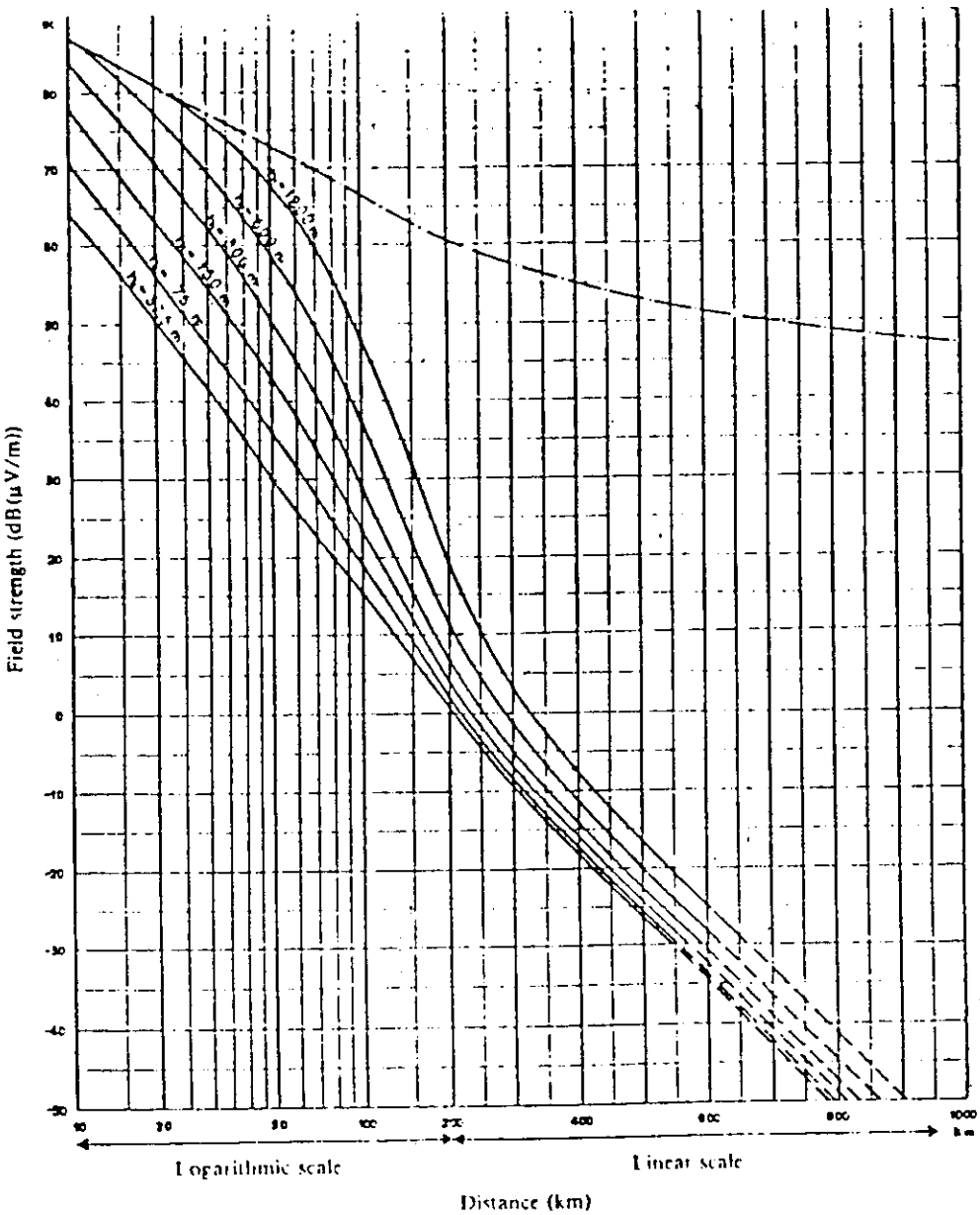
5.1.2 The software is menu driven and its hardware requirements are minimal. It provides powerful graphic support and has ful flexibility for future modification/revision. The program is so designed to assist the planner in making a quick assessment and thus work out a detailed plan taking into account the frequency plan drawn for the country/region.

5.1.3 The package has some novel features. The program has got the facility to display CCIR field strength prediction curves given in Rec.370-5. For any given distance from the transmitter, the field strength generated by a 1 KW transmitter with standard antenna of each heights can be immediately obtained. The graphic display of coverage area with and without interference gives a fair assessment of coverage likely to be provided by the transmitter. A arrow on the screen immediately displays the field strength that will be provided at a given point within the service area. Another important tool for the planner is the possibility of rotating the plot of the antenna gain pattern to any desired angle to help in optimum planning of the network. The correction factor introduced to variation of h can also be plotted by the program. In the coverage plot, the scale of th plot can be changed to facilitate the planner. The experimentation data can be saved for comparison with other parameters being changed to facilitate the planner to arrive at the optimum mix of transmitter power and antenna pattern.

5.1.4 The package has been developed for ease of operation and does not require specific knowledge of wave propagation planning and computers. It is user friendly and can be easily adapted.

ANNEXURE - I

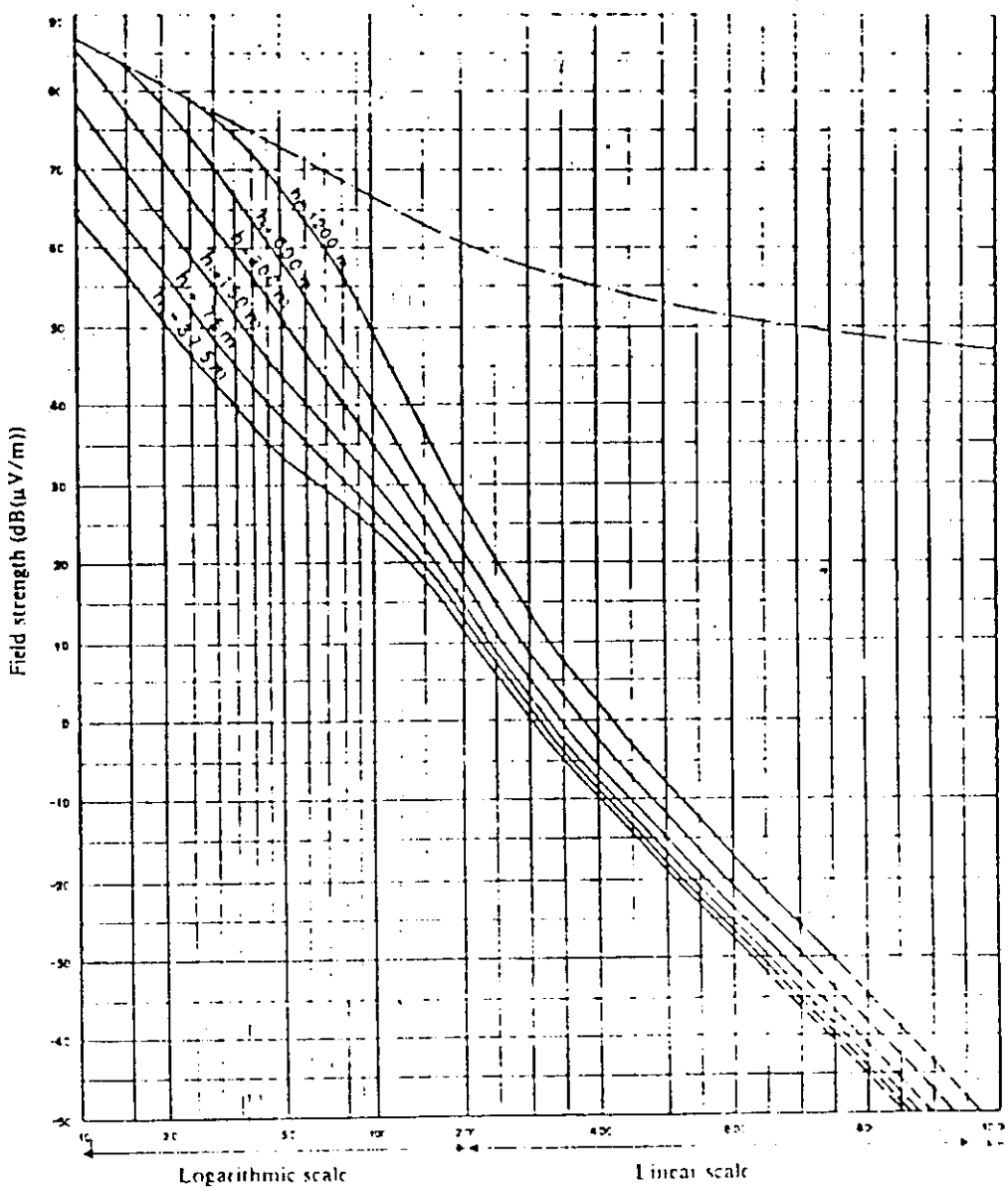
FIELD STRENGTH PREDICTION CURVES



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - 1 and - 50% of the time - 50% of the locations - h_2 = 10 m - Δh = 50 m

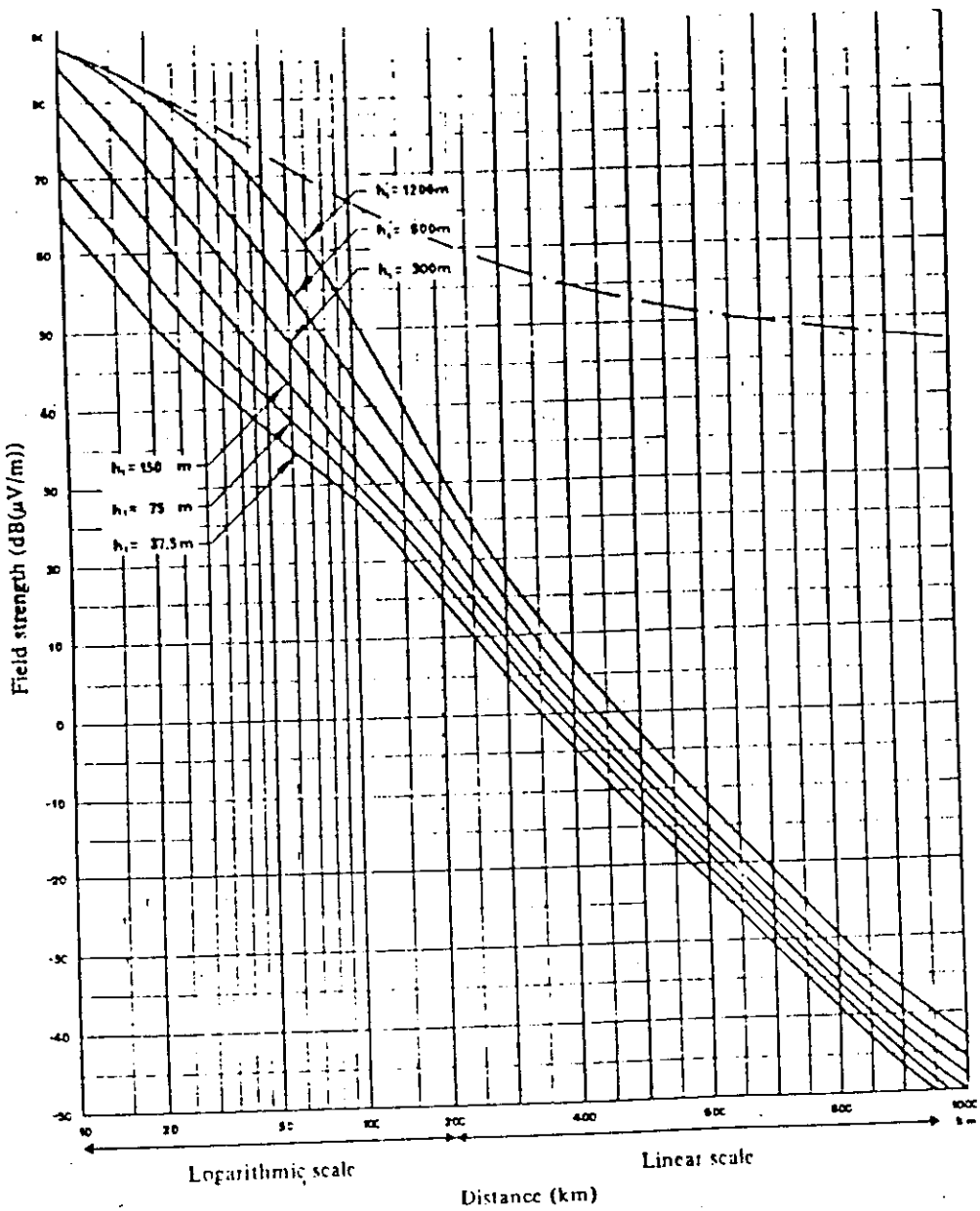
Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Land - 10% of the time - 50% of the locations - h_2 = 10 m - Δh = 50 m

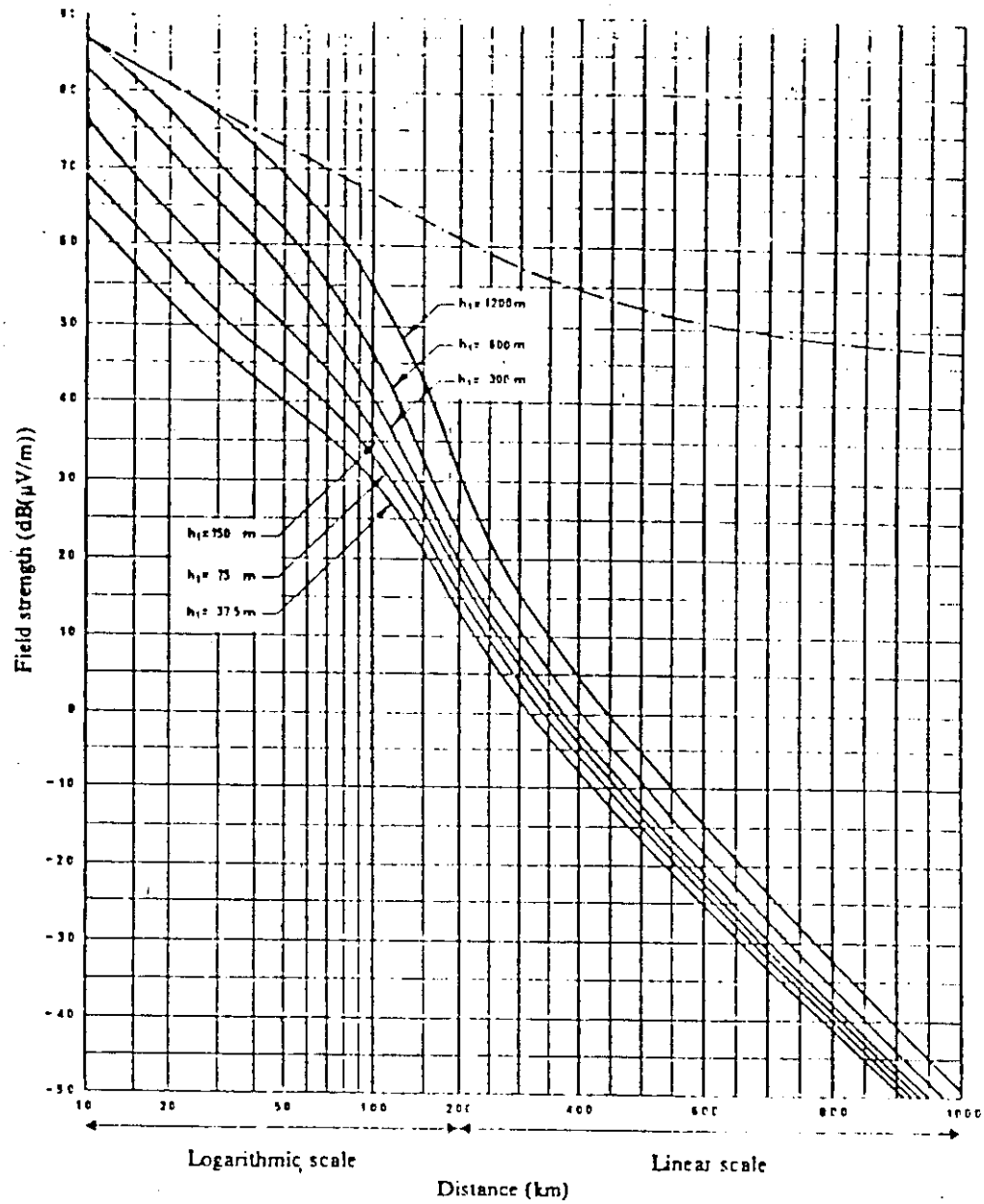
Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Land - 5% of the time - 50% of the locations - h_2 = 10 m - Δh = 50 m

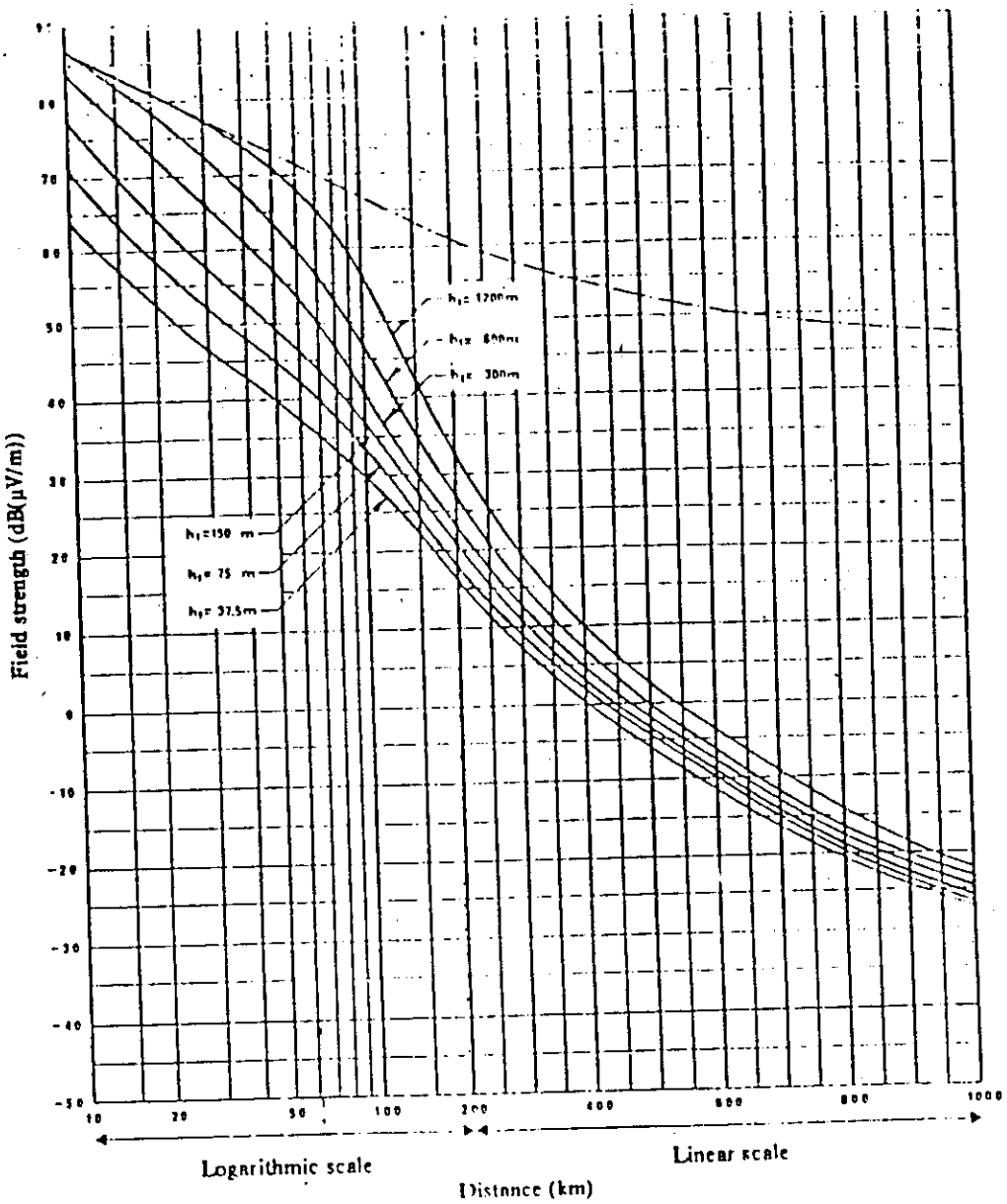
— · — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Cold sea - 10% of the time - 50% of the locations - h_2 = 10 m

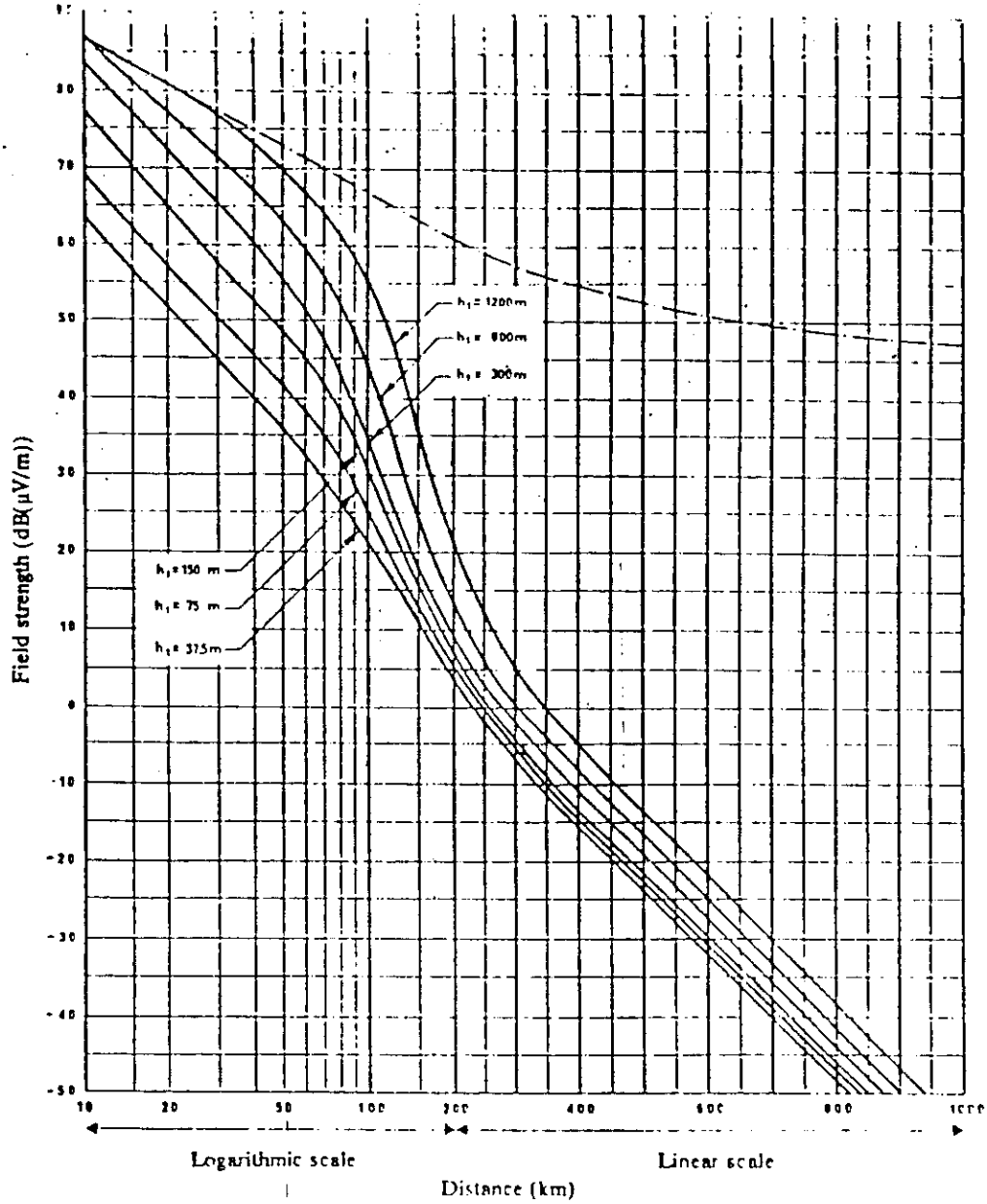
— · — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Warm sea - 10% of the time - 50% of the locations - h_2 = 10 m

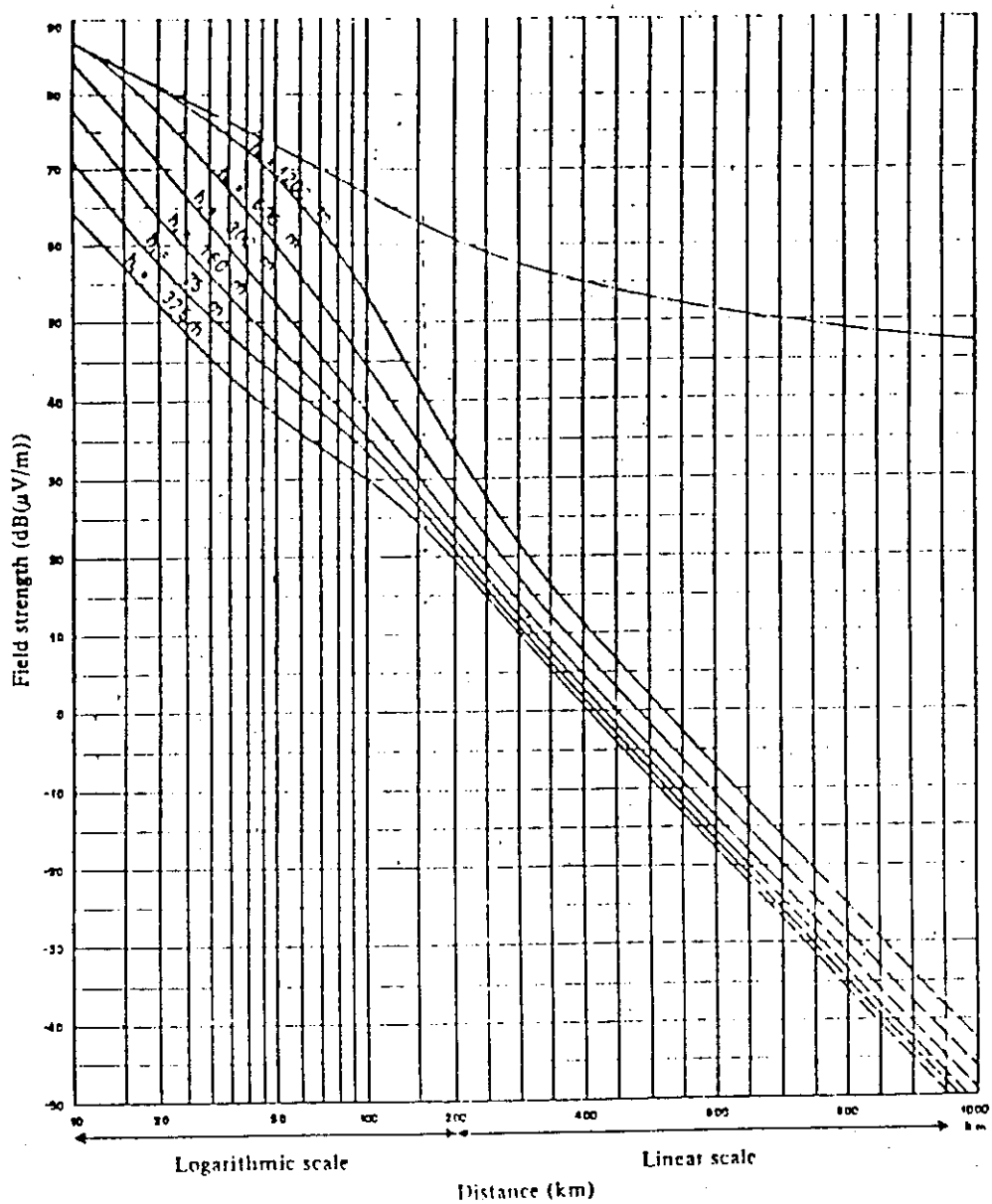
— · — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Sea - 50% of the time - 50% of the locations - h_2 = 10 m

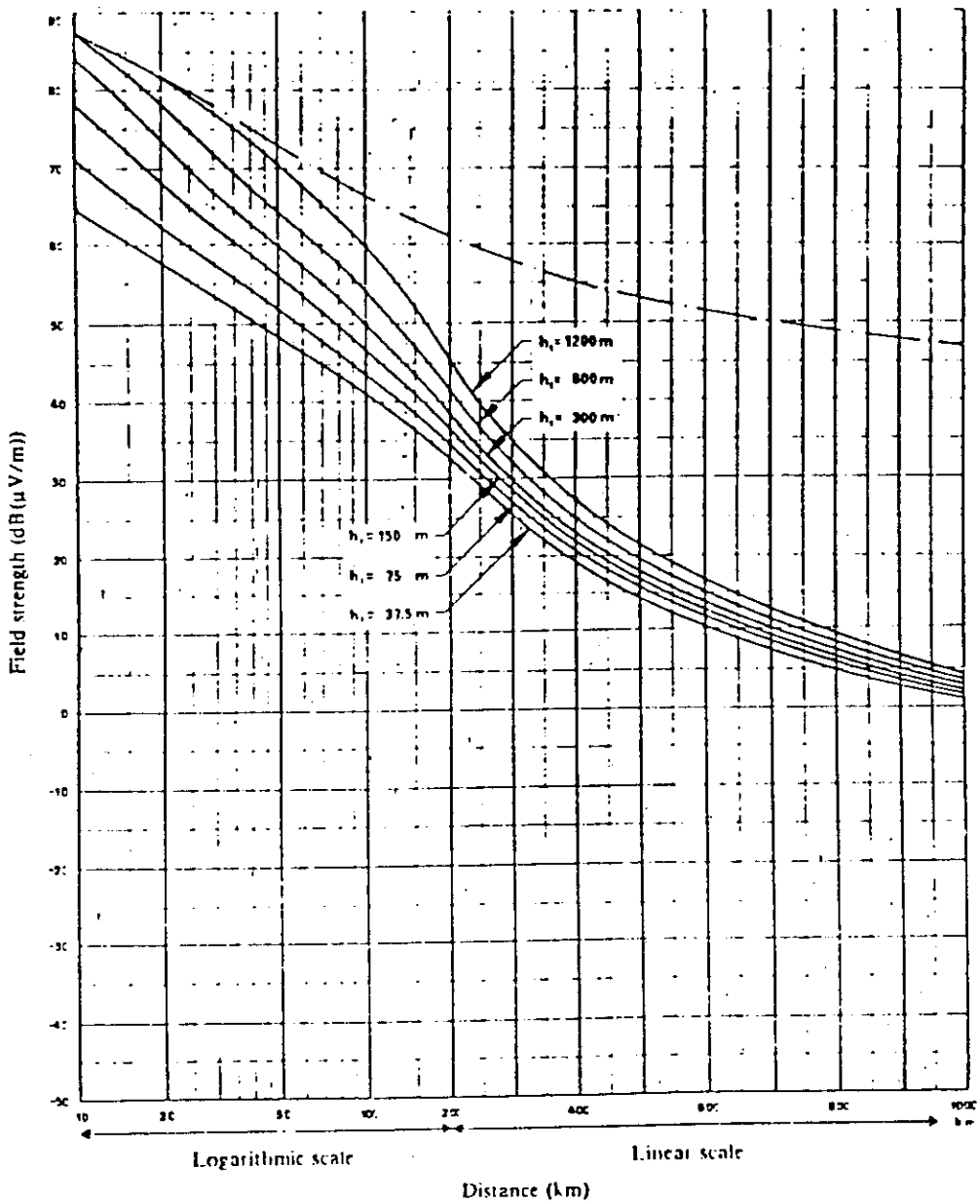
– – – – Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Land - 1% of the time - 50% of the locations - h_2 = 10 m - Δh = 50 m

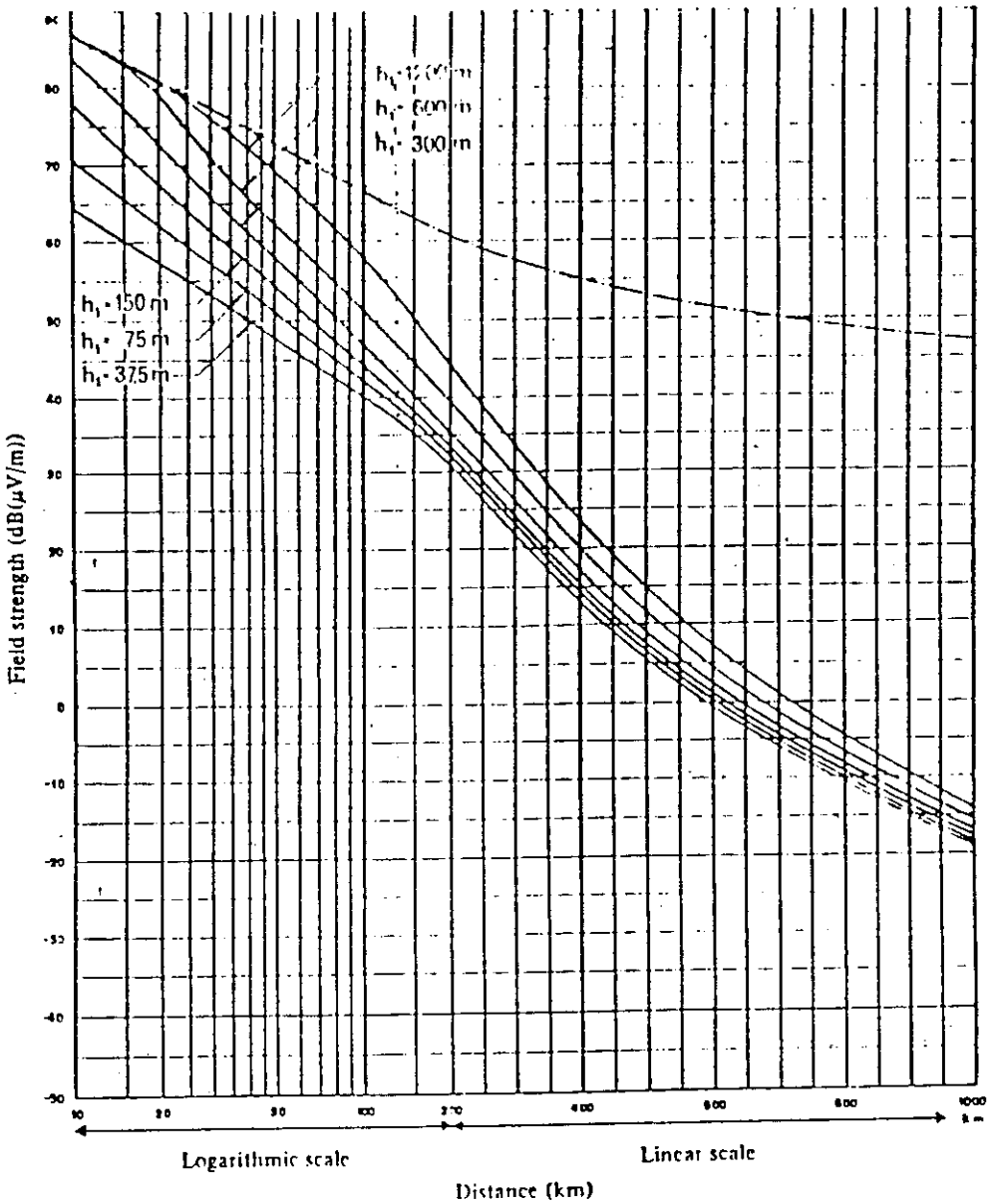
—·—·— Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Warm sea (excluding areas subject to extreme super-refraction) - 1% of the time - 50% of the locations - h_2 = 10 m

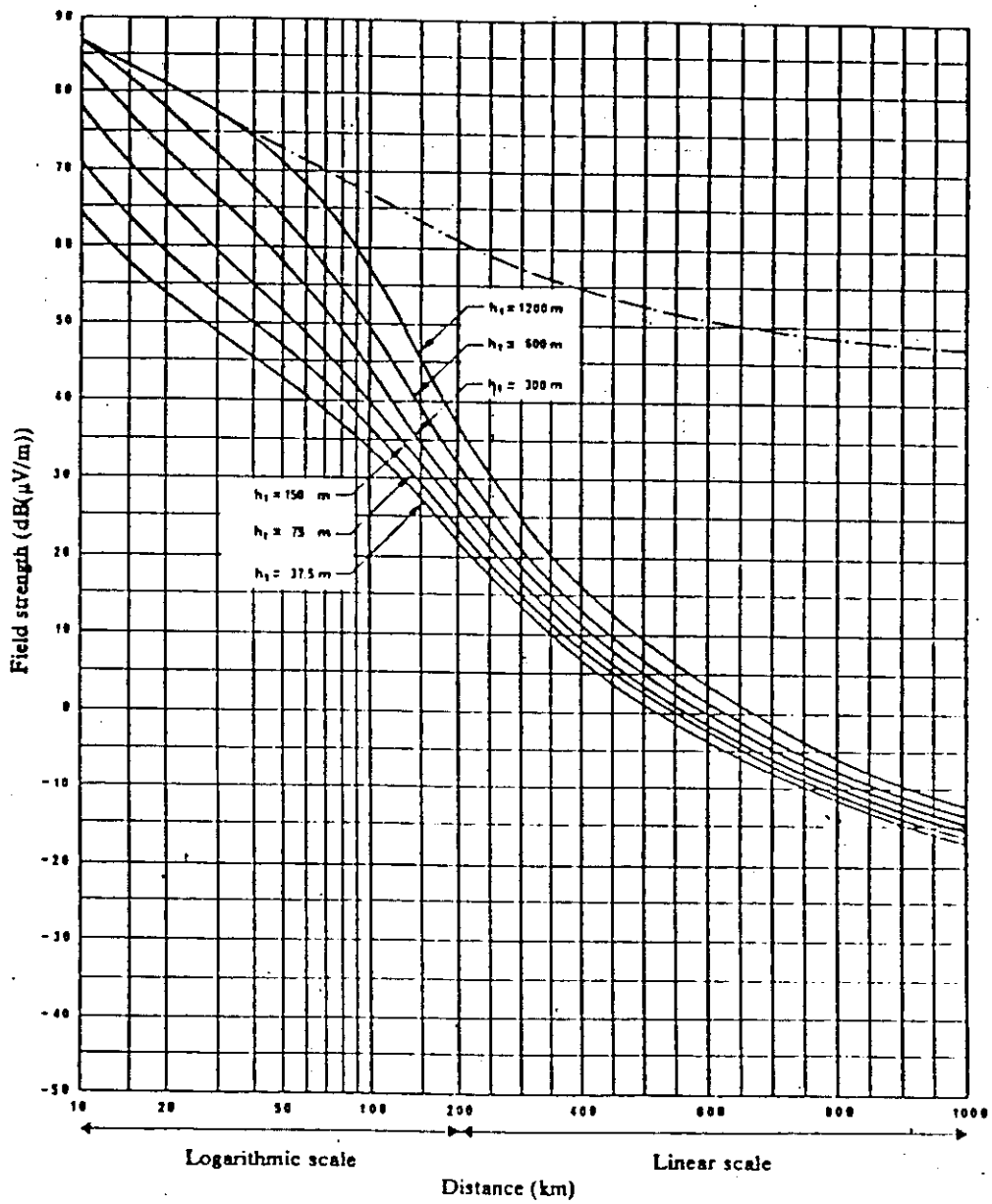
Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) – Cold sea – 1% of the time – 50% of the locations – h_2 = 10 m

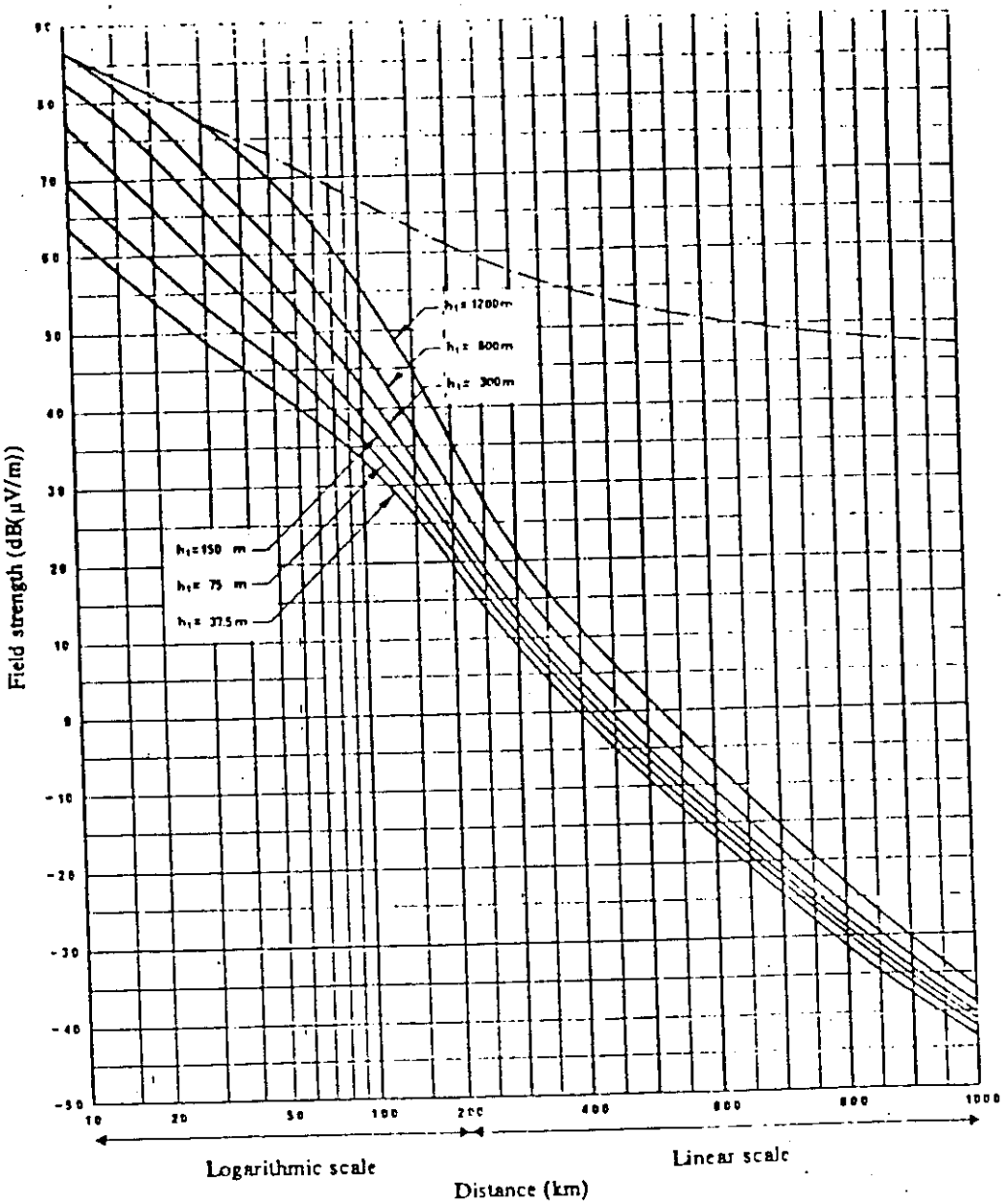
—·— Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Warm sea - 5% of the time - 50% of the locations - h_2 = 10 m

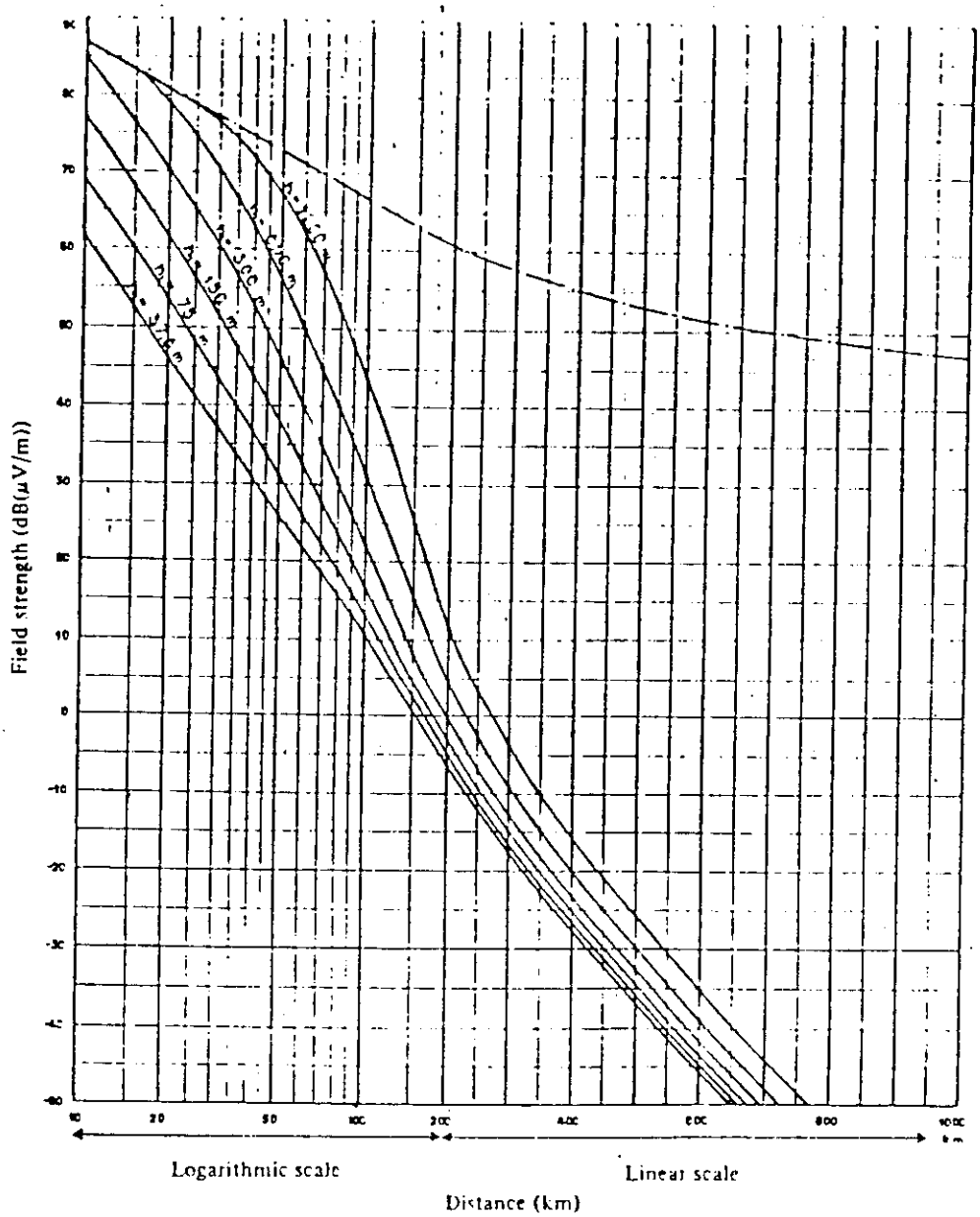
— · — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 30 to 250 MHz (Bands I, II and III) - Cold sea - 5% of the time - 50% of the locations - h_2 = 10 m

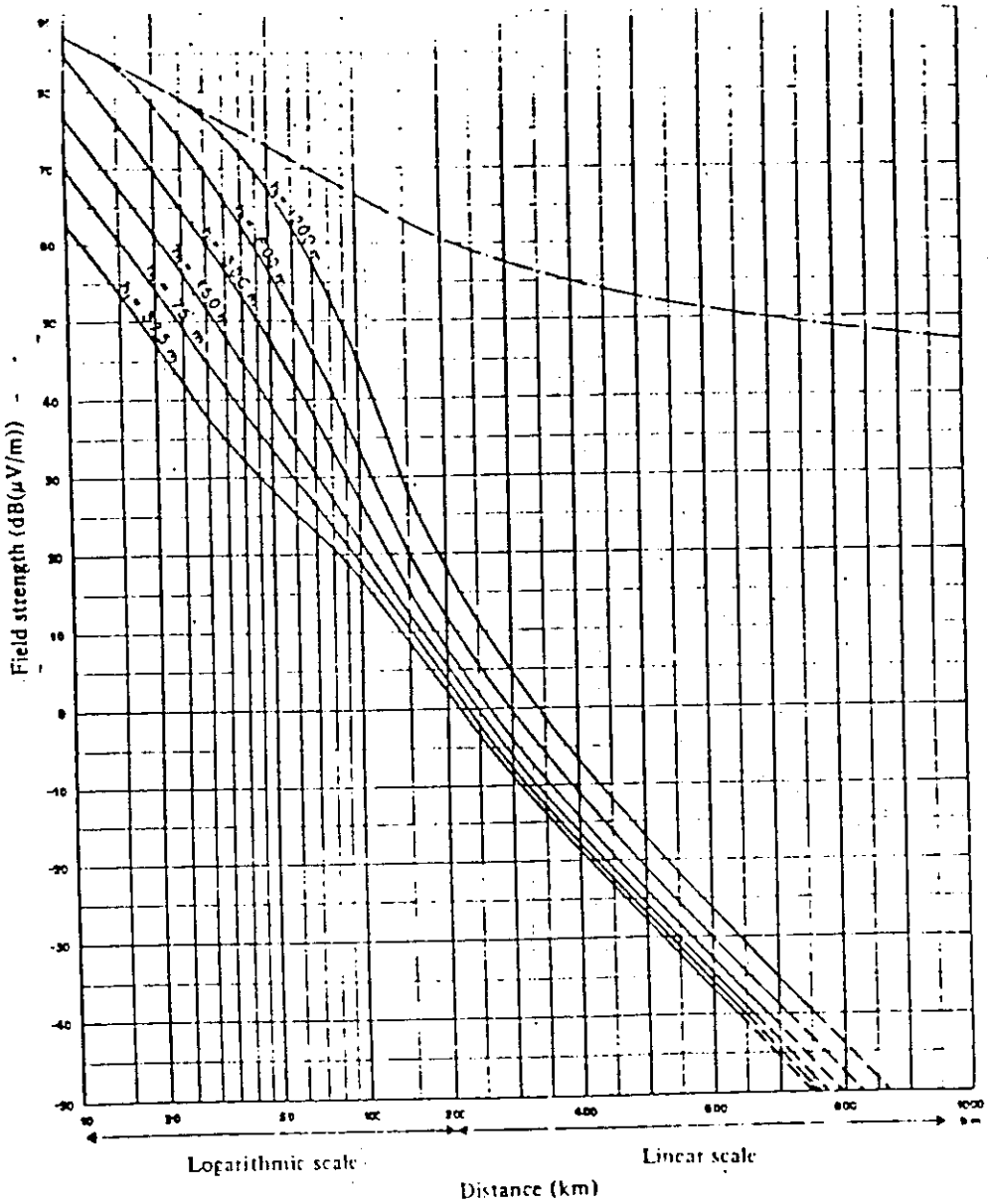
— · — · — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - Land - 50% of the time - 50% of the locations - $h_2 = 10$ m - $\Delta h = 50$ m

— — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - Land - 10% of the time - 50% of the locations - h_2 = 10 m - Δh = 50 m

— · — Free space

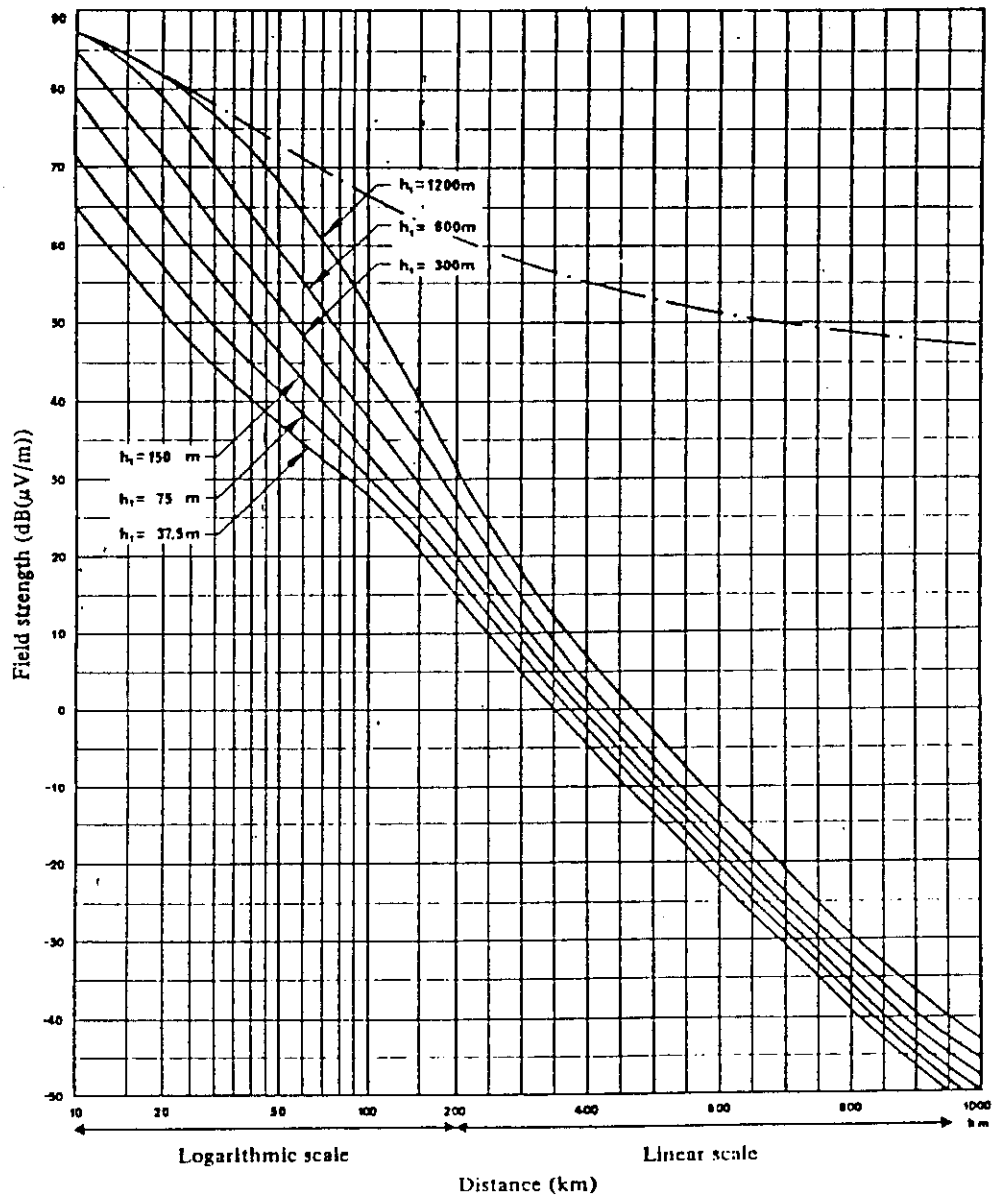
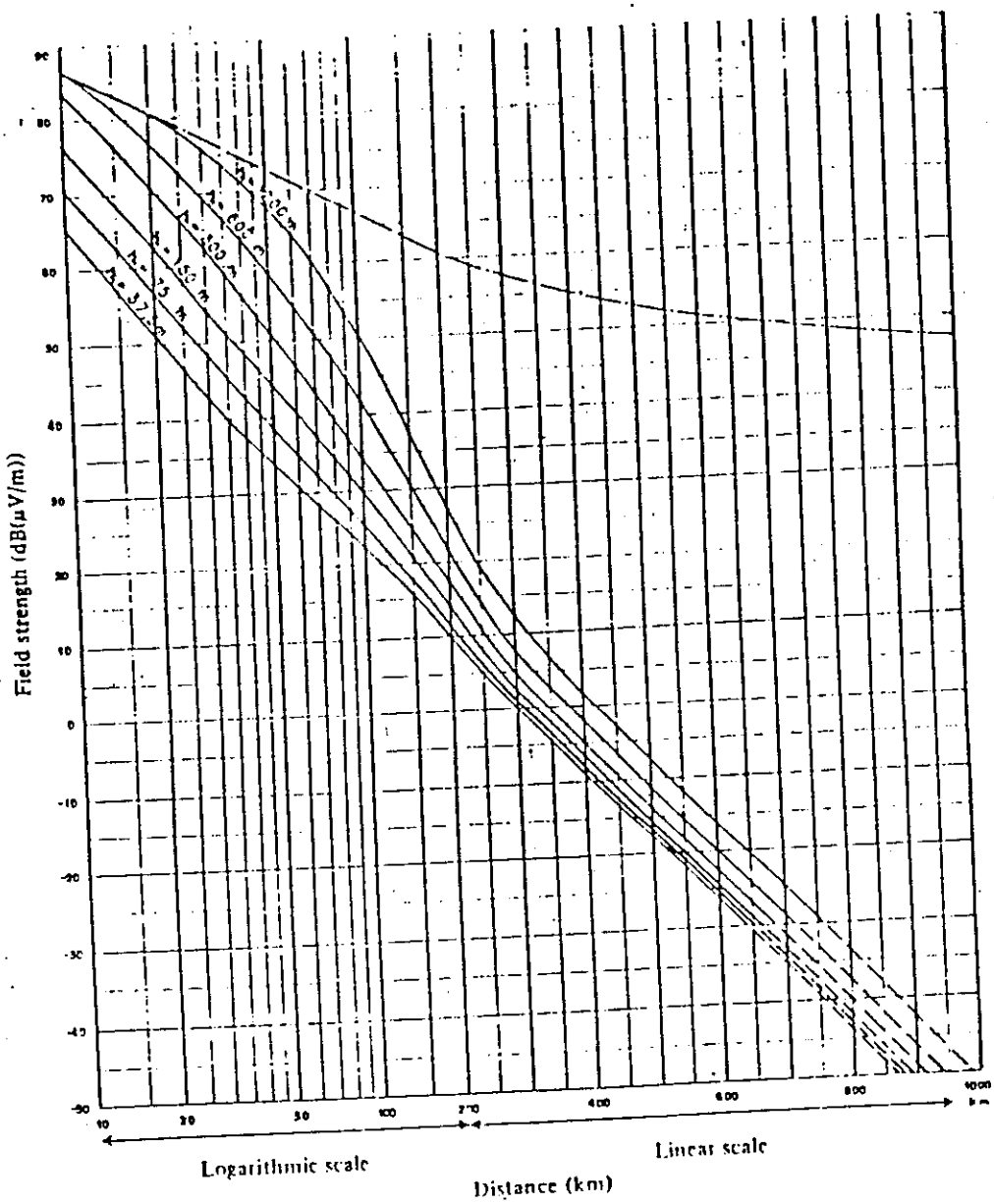


FIGURE 3*a* – *Field strength (dB(μV/m)) for 1 kW e.r.p.*

Frequency: 30 to 250 MHz (Bands I, II and III) - Land - 5% of the time - 50% of the locations - $h_2 = 10$ m - $\Delta h = 50$ m

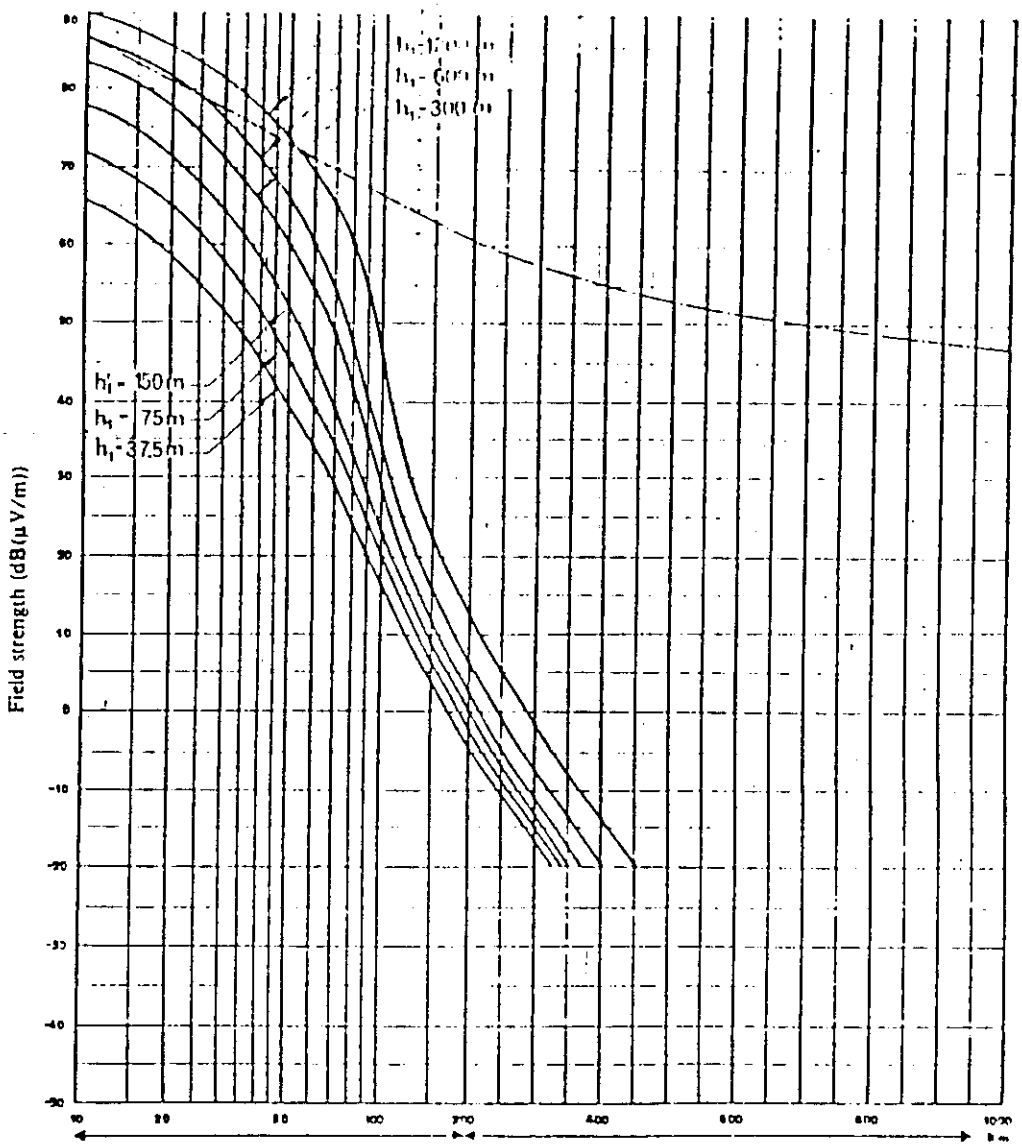
—·— Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - 1 and - 1% of the time - 50% of the locations - h_2 = 10 m - Δh = 50 m

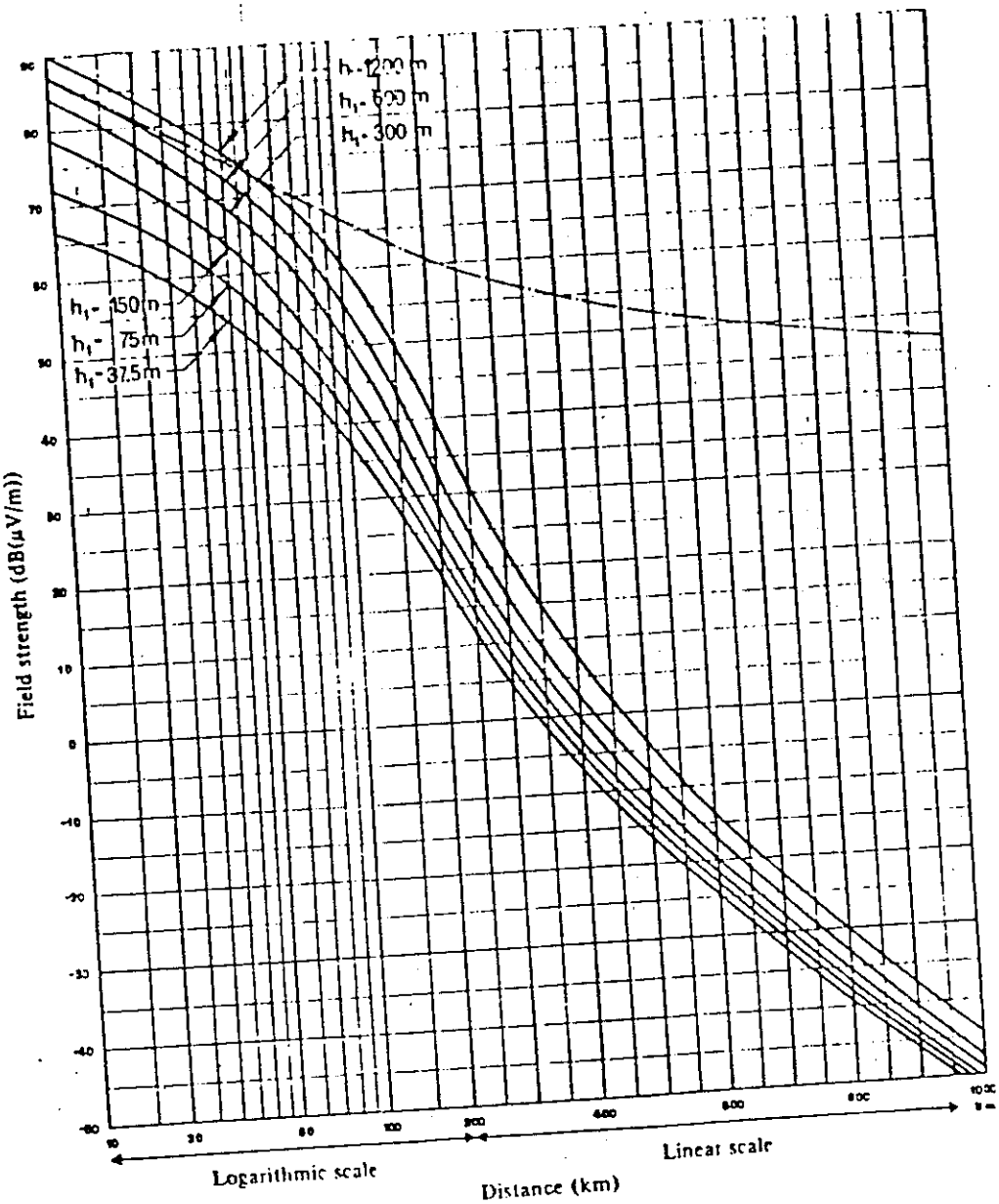
— — — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) – Sea – 50% of the time – 50% of the locations – h_2 = 10 m

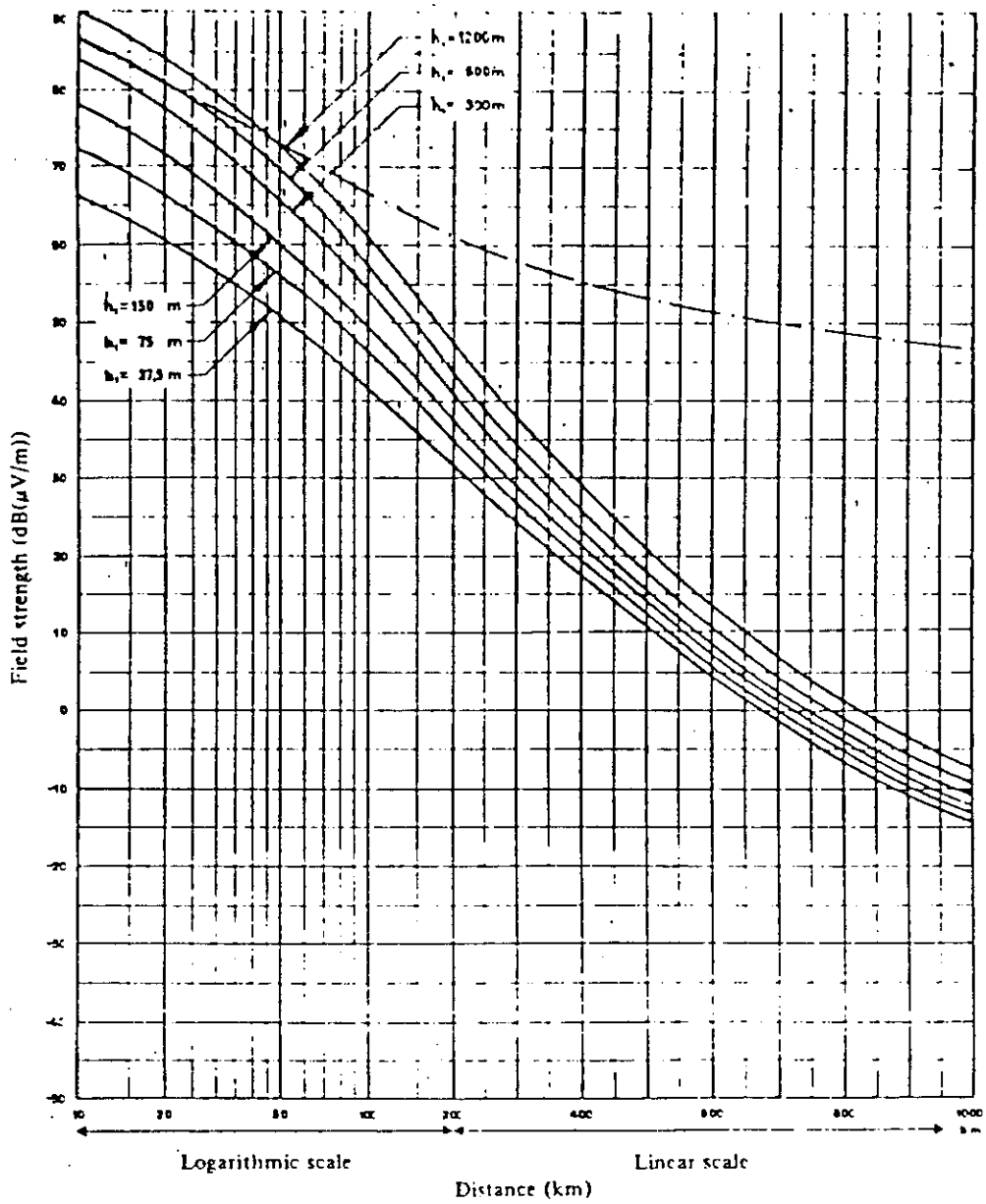
Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - Cold sea - 10% of the time - 50% of the locations - $h_2 = 10$ m

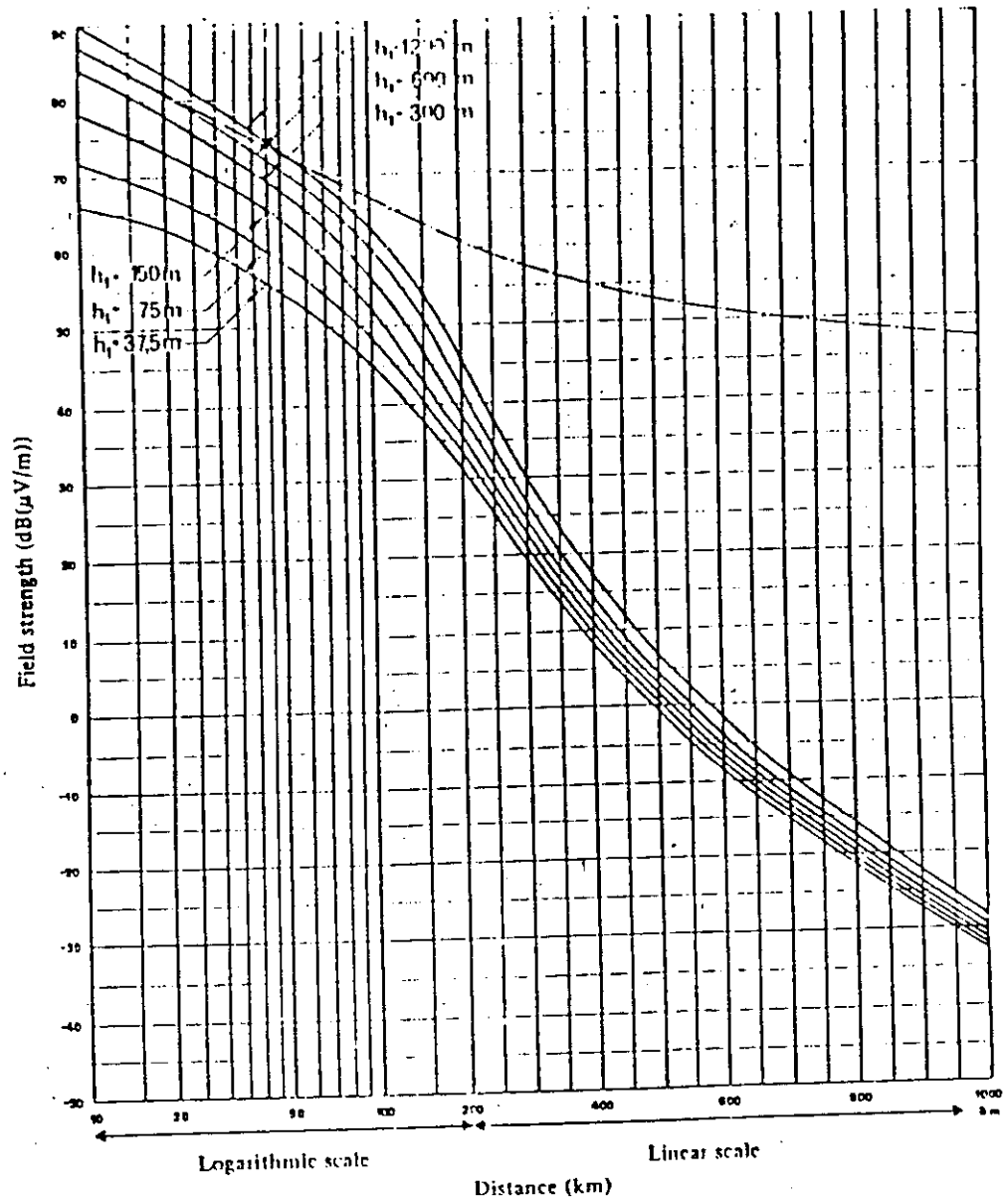
— — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - Warm sea - 10% of the time - 50% of the locations - h_2 = 10 m

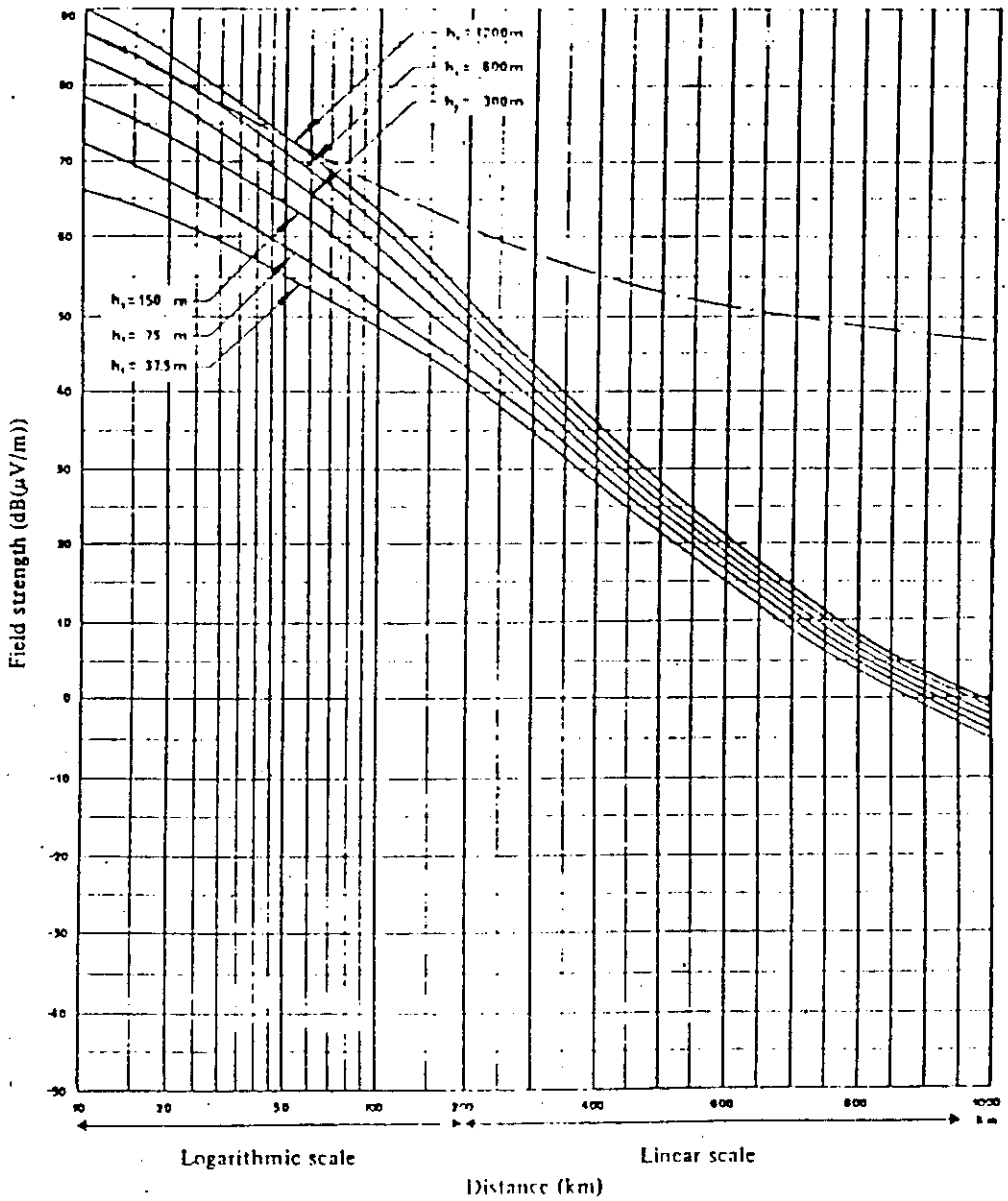
— — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - Cold sea - 5% of the time - 50% of the locations - h_2 = 10 m

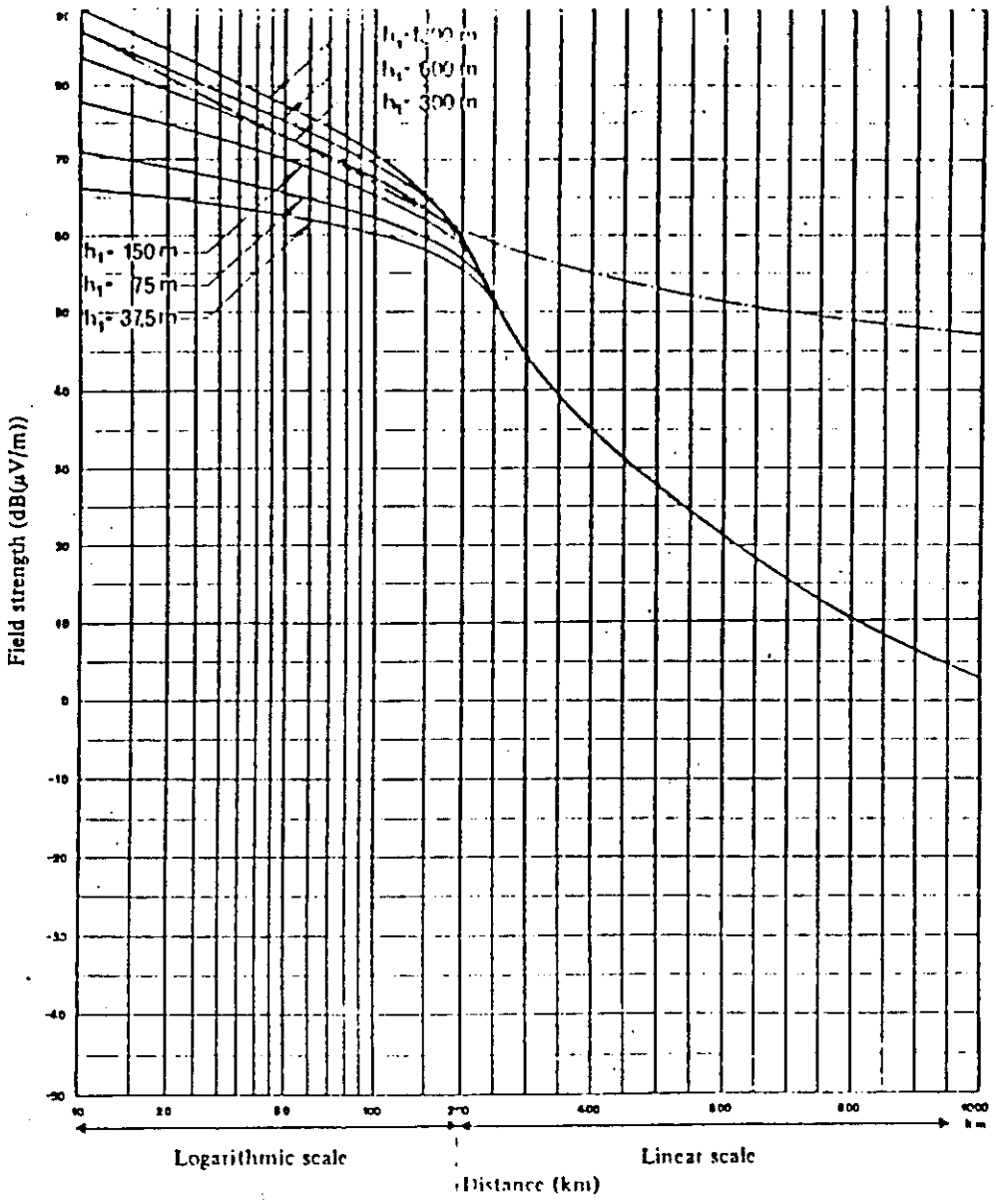
— · — Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - Warm sea - 5% of the time - 50% of the locations - h_2 = 10 m

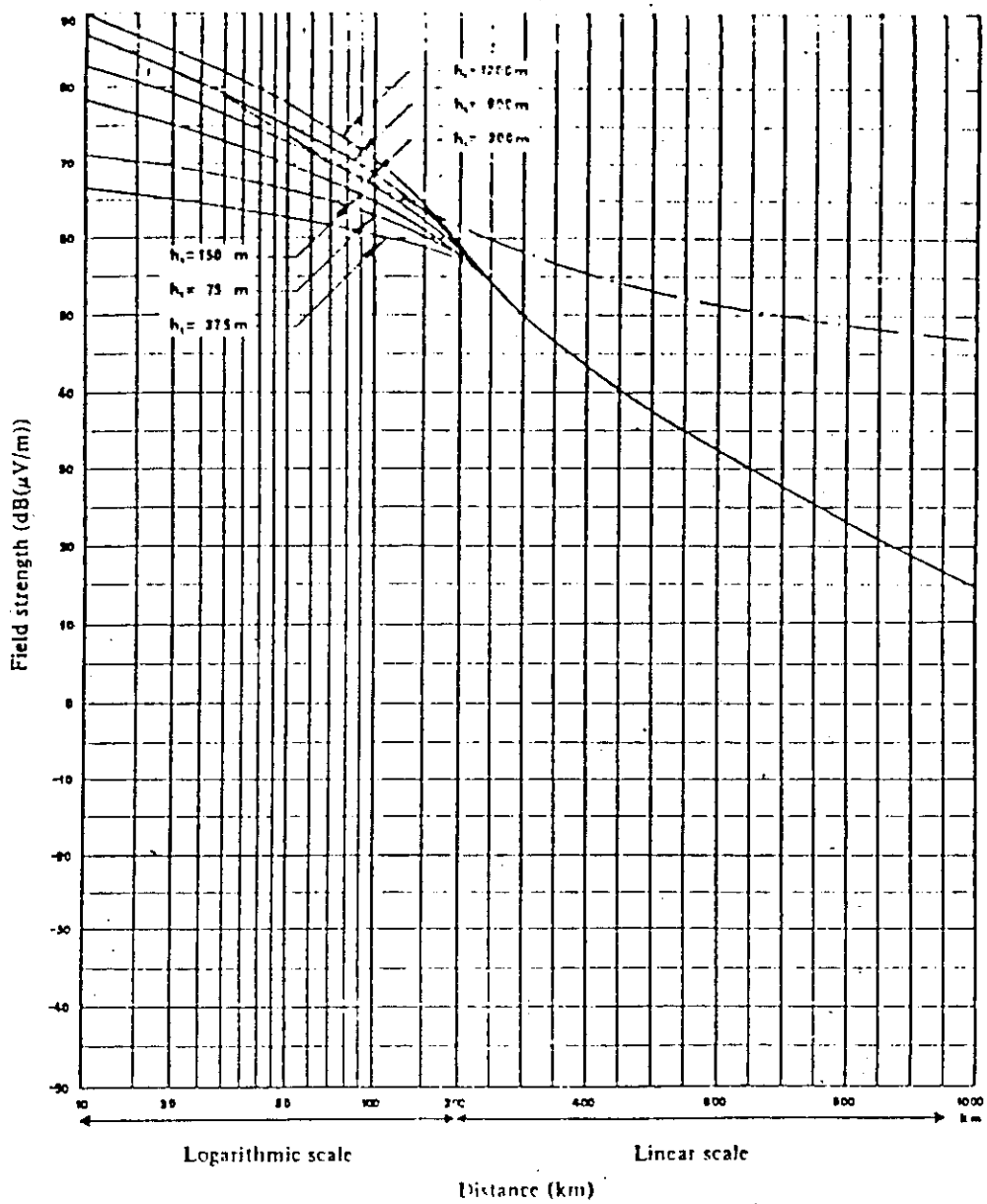
Free space



Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) - Cold sea - 1% of the time - 50% of the locations - $h_2 = 10$ m

— · — · — Free space



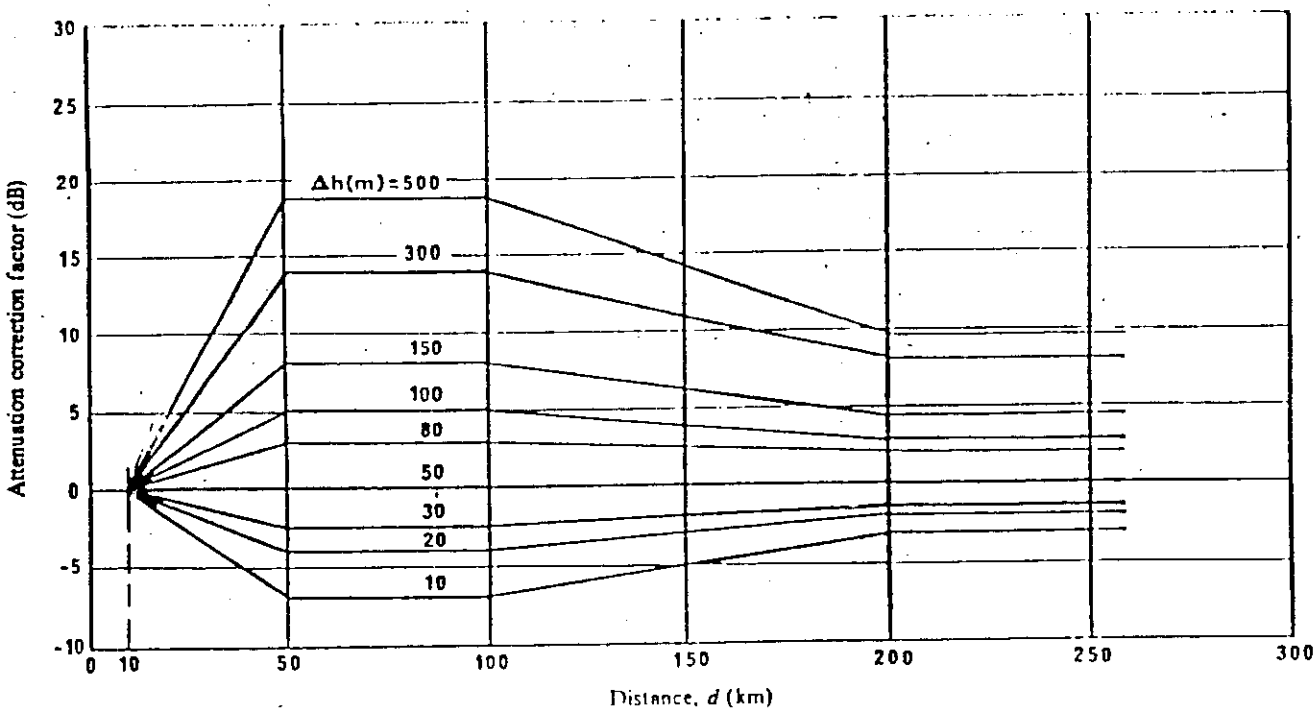
Field strength (dB(μV/m)) for 1 kW e.r.p.

Frequency: 450 to 1000 MHz (Bands IV and V) – Warm sea (excluding areas subject to extreme super-refraction) – 1% of the time – 50% of the locations – h_2 = 10 m

— — Free space

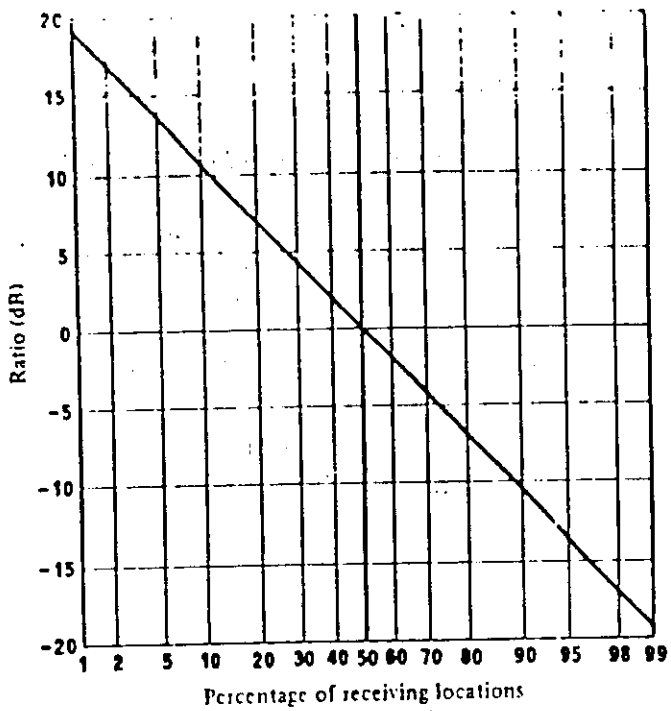
ANNEXURE - II

ATTENUATION CORRECTION FACTOR



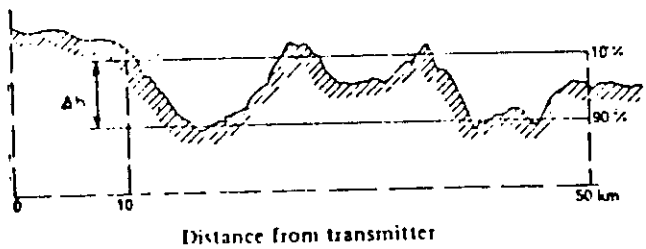
Attenuation correction factor as a function of the distance d (km) and Δh

Frequencies 80 to 250 MHz (Bands II and III)

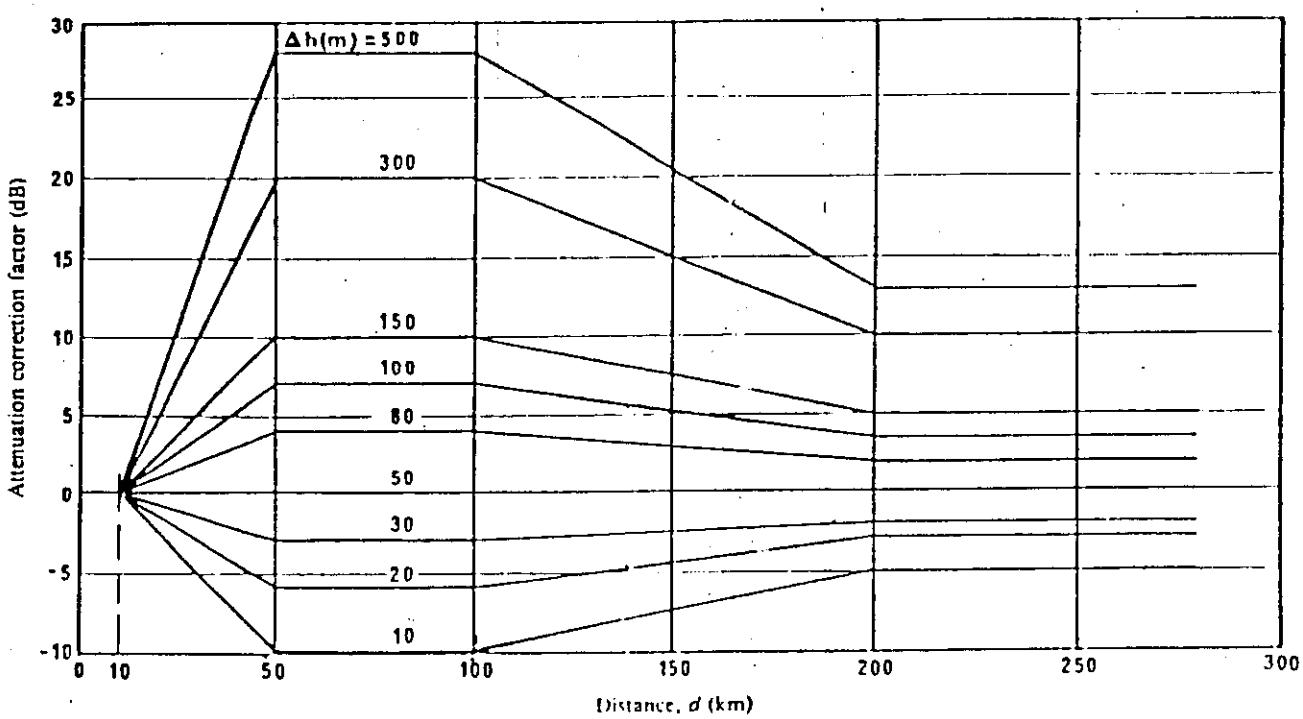


Ratio (dB) of the field strength for a given percentage of the receiving locations to the field strength for 50% of the receiving locations

Frequency : 30 to 250 MHz (Bands I, II and III)

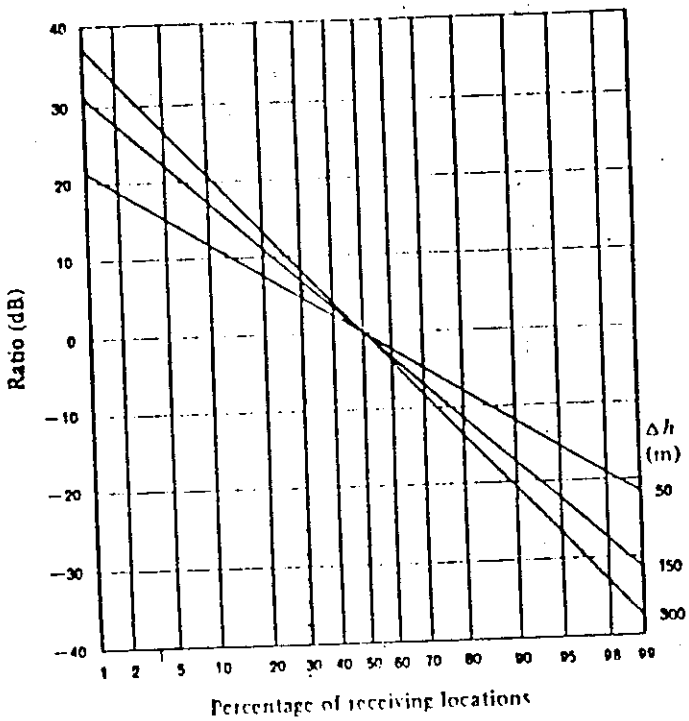


Application of the parameter Δh for broadcasting services



Attenuation correction factor as a function of the distance d (km) and Δ h

Frequencies 450 to 1000 MHz (Bands IV and V)



Ratio (dB) of the field strength for a given percentage of the receiving locations to the field strength for 50% of the receiving locations

Frequency : 450 to 1000 MHz (Bands IV and V)

ANNEXURE - III

PROTECTION RATIOS FOR F.M SOUND BROADCATING SERVICE

ANNEXURE-3

Protection Ratio

Frequency difference (KHz)	Protection Ratio (dB) Mono		Stereo	
	Steady State	Tropospheric	Steady State	Tropospheric
000	36	28	45	37
025	31	27	51	43
050	24	22	51	43
075	16	16	45	37
100	12	12	33	25
150	8	8	18	14
200	6	6	7	7
250	2	2	2	2
300	-7	-7	-7	-7
350	-15	-15	-15	-15
400	-20	-20	-20	-20

ANNEXURE – IV

PROTECTION RATIOS FOR T.V SERVICE

ANNEXURE- 4

on Ratios for Co-channel Interference

ne Systems

		Offset (multiples of 1/12 line-frequency)											
		0	1	2	3	4	5	6	7	8	9	10	11	12
r Stability Tropospheric		45	44	40	34	30	28	27	28	30	34	40	44	45
sion offset	Steady State	52	51	48	44	40	36	33	36	40	44	48	51	52
er Stability Tropospheric		32	34	30	26	22	22	24	22	22	26	30	34	38
Hz														
ision offset	Steady State	36	38	34	30	27	27	30	27	27	30	34	38	42

2. Protection Ratios for Lower Adjacent Channel Interference

VHF Bands

Protection ratio for frequency-modulated sound carrier

- Systems N and M : -13 dB
- all other systems : -9 dB

for amplitude modulated sound carrier

- System L (vision-to-sound power ratio 10 dB) : -8 dB

UHF Bands

525-line Systems : Protection Ratio = -13 dB

625-line systems

Wanted Signal	Unwanted Signal G	H	I	D	K	K1	L
G	-9	-9	-9	-9	-9	-9	-5
H	-9	-9	-9	+13	+13	+13	+17
I	-9	-9	-9	+13	+13	+13	+17
D	-9	-9	-9	-9	-9	-9	-5
K	-9	-9	-9	-9	-9	-9	-5
K1	-9	-9	-9	-9	-9	-9	+17
L	-9	-9	-9	0	-12	-12	-8

3. Protection Ratios for Upper Adjacent Channel Interference

VHF and UHF Bands

Protection Ratio : for system N : -10 dB

for systems D and K : -6 dB

for all other systems: -12 dB

4. Protection Ratios For Overlapping Channel Interference

525-line Systems (M/NTSC and M/PAL) Tropospheric interference:

	Frequency difference (MHz)										
	-1.5	-1.0	-0.75	0.3	1.0	2.5	3.0	3.5	3.7	4.1	4.5
NTSC (Non-controlled)	0	30	40	50	50	37	45	50	50	45	15
PAL (Non-controlled)	0	30	40	50	50	37	45	45	45	45	15
Monochrome (Non-controlled)	0	30	40	50	50	37	32	25	22	20	15
Monochrome (Non-precision)	0	15	23	33	33	25	22	20	19	17	15

Continuous interference - 625 line systems - H,I,K1,L television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range						
	-1.25	-0.5	0.0	0.5	1.0	2.0	3.0
0	30	37	38	44	44	42	36
1	29	38	40	42	42	41	36
2	27	34	36	38	38	37	34
3	24	30	32	34	34	33	31
4	22	27	29	31	31	31	30
5	22	27	29	31	31	31	30
6	23	29	32	33	33	32	30
7	22	27	29	31	31	31	30
8	22	27	29	31	31	31	30
9	24	30	32	34	34	33	31
10	27	34	36	38	38	37	34
11	29	38	40	42	42	41	36
12	30	37	44	44	44	42	36

Continuous interference - 625 line systems - B,D,G,K television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range						
	-1.25	-0.5	0.0	0.5	1.0	2.0	3.0
0	22	37	38	44	44	42	36
1	22	38	40	42	42	41	36
2	20	34	36	38	38	37	34
3	17	30	32	34	34	33	31
4	15	27	29	31	31	31	30
5	15	27	29	31	31	31	30
6	16	29	32	33	33	32	30
7	15	27	29	31	31	31	30
8	15	27	29	31	31	31	30
9	17	30	32	34	34	33	31
10	20	34	36	38	38	37	34
11	22	38	40	42	42	41	36
12	22	37	44	44	44	42	36

Troposheric interference - 625 line systems - B,D,G,K television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range -1.25	-0.5	0.0	0.5	1.0	2.0	3.0
0	11	32	34	40	40	37	31
1	11	33	36	39	39	36	31
2	9	29	32	35	35	33	29
3	7	25	28	31	31	29	26
4	5	22	24	26	26	25	24
5	5	22	24	26	26	25	24
6	5	24	26	28	28	26	24
7	5	22	24	26	26	25	24
8	5	22	24	26	26	25	24
9	7	25	28	31	31	29	26
10	9	29	32	35	35	33	29
11	11	33	36	39	39	36	31
12	11	32	40	40	40	37	31

Troposheric interference - 625 line systems - H,I,K1,L television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range						
	-1.25	-0.5	0.0	0.5	1.0	2.0	3.0
0	23	32	34	40	40	37	31
1	23	33	36	39	39	36	31
2	21	29	32	35	35	33	29
3	19	25	28	31	31	29	26
4	17	22	24	26	26	25	24
5	17	22	24	26	26	25	24
6	17	24	26	28	28	26	24
7	17	22	24	26	26	25	24
8	17	22	24	26	26	25	24
9	19	25	28	31	31	29	26
10	21	29	32	35	35	33	29
11	23	33	36	39	39	36	31
12	23	32	40	40	40	37	31

-c interference - 625 line systems - H,I,K1,L television systems

(Non-precision Offset)

es line y)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range						
	-1.25	-0.5	0.0	0.5	1.0	2.0	3.0
	32	44	47	50	50	44	36
	31	43	46	49	49	42	34
	28	39	42	45	45	39	32
	25	34	36	39	39	35	29
	22	30	32	35	35	32	27
	20	28	30	32	32	30	25
5	19	27	29	31	31	29	24
6	20	28	30	32	32	30	25
7	22	30	32	35	35	32	27
8	25	34	36	39	39	35	29
9	28	39	42	45	45	39	32
10	31	43	46	49	49	42	34
11	32	44	47	50	50	44	36
12							

Continuous interference - 625 line systems - H,I,K1,L television systems
(Non-precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range						
	-1.25	-0.5	0.0	0.5	1.0	2.0	3.0
0	40	50	54	58	58	54	44
1	38	49	53	57	57	53	43
2	34	46	50	55	55	51	41
3	30	42	46	50	50	46	38
4	28	38	42	45	45	42	35
5	26	35	38	41	41	38	32
6	24	33	35	37	37	36	30
7	26	35	38	41	41	38	32
8	28	38	42	45	45	42	35
9	30	42	46	50	50	46	38
10	34	46	50	55	55	51	41
11	38	49	53	57	57	53	43
12	40	50	54	58	58	54	44

Continuous interference - 625 line systems - B,D,G,K television systems
(Non-precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range						
	-1.25	-0.5	0.0	0.5	1.0	2.0	3.0
0	32	50	54	58	58	54	44
1	30	49	53	57	57	53	43
2	27	46	50	55	55	51	41
3	23	42	46	50	50	46	38
4	21	38	42	45	45	42	35
5	19	35	38	41	41	38	32
6	17	33	35	37	37	36	30
7	19	35	38	41	41	38	32
8	21	38	42	45	45	42	35
9	23	42	46	50	50	46	38
10	27	46	50	55	55	51	41
11	30	49	53	57	57	53	43
12	32	50	54	58	58	54	44

Troposheric interference - 625 line systems - B,D,G,K television systems
(Non-precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Luminance range						
	-1.25	-0.5	0.0	0.5	1.0	2.0	3.0
0	23	44	47	50	50	44	36
1	20	43	46	49	49	42	34
2	17	39	42	45	45	39	32
3	13	34	36	39	39	35	29
4	10	30	32	35	35	32	27
5	8	28	30	32	32	30	25
6	7	27	29	31	31	29	24
7	8	28	30	32	32	30	25
8	10	30	32	35	35	32	27
9	13	34	36	39	39	35	29
10	17	39	42	45	45	39	32
11	20	43	46	49	49	42	34
12	23	44	47	50	50	44	36

Tropospheric interference - 625 line systems - PAL television systems
(Non-precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range 3.0	3.6	4.8	5.7	6.0
0	36	35	35	18	18
1	34	39	39	20	20
2	32	42	42	22	22
3	29	45	45	25	25
4	27	42	42	22	22
5	25	39	39	20	20
6	24	35	35	18	18
7	25	35	35	18	18
8	27	39	39	20	20
9	29	42	42	22	22
10	32	39	39	20	20
11	34	35	35	18	18
12	36	35	35	18	18

Continuous interference - 625 line systems - PAL television systems
(Non-precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range				
	3.0	3.6	4.8	5.7	6.0
0	44	45	45	30	30
1	43	48	48	32	32
2	41	51	51	33	33
3	38	53	53	35	35
4	35	51	51	33	33
5	32	48	48	32	32
6	30	45	45	30	30
7	32	45	45	30	30
8	35	48	48	32	32
9	38	51	51	33	33
10	41	48	48	32	32
11	43	45	45	30	30
12	44	45	45	30	30

Tropospheric interference - 625 line systems - PAL television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range				
	3.0	3.6	4.8	5.7	6.0
0	31	28	28	15	15
1	31	31	31	16	16
2	29	34	34	17	17
3	26	35	35	18	18
4	24	34	34	17	17
5	24	31	31	16	16
6	24	28	28	15	15
7	24	28	28	15	15
8	24	31	31	16	16
9	26	34	34	17	17
10	29	31	31	16	16
11	31	28	28	15	15
12	31	28	28	15	15

Continuous interference - 625 line systems - PAL television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range				
	3.0	3.6	4.8	5.7	6.0
0	36	34	34	21	21
1	36	36	36	22	22
2	34	39	39	24	24
3	31	40	40	26	26
4	30	39	39	24	24
5	30	36	36	22	22
6	30	34	34	21	21
7	30	34	34	21	21
8	30	36	36	22	22
9	31	39	39	24	24
10	34	36	36	22	22
11	36	34	34	21	21
12	36	34	34	21	21

Tropospheric interference - 625 line systems - SECAM television systems
(Non-precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range				
	3.0	3.6	4.8	5.7	6.0
0	36	40	40	25	25
1	34	40	40	25	25
2	32	40	40	25	25
3	29	40	40	25	25
4	27	40	40	25	25
5	25	40	40	25	25
6	24	40	40	25	25
7	25	40	40	25	25
8	27	40	40	25	25
9	29	40	40	25	25
10	32	40	40	25	25
11	34	40	40	25	25
12	36	40	40	25	25

Continuous interference - 625 line systems - SECAM television systems
(Non-precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range				
	3.0	3.6	4.8	5.7	6.0
0	44	45	45	30	30
1	43	45	45	30	30
2	41	45	45	30	30
3	38	45	45	30	30
4	35	45	45	30	30
5	32	45	45	30	30
6	30	45	45	30	30
7	32	45	45	30	30
8	35	45	45	30	30
9	38	45	45	30	30
10	41	45	45	30	30
11	43	45	45	30	30
12	44	45	45	30	30

Tropospheric interference - 625 line systems - SECAM television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range 3.0	3.6	4.8	5.7	6.0
0	31	33	33	18	18
1	31	33	33	18	18
2	29	33	33	18	18
3	26	33	33	18	18
4	24	33	33	18	18
5	24	33	33	18	18
6	24	33	33	18	18
7	24	33	33	18	18
8	24	33	33	18	18
9	26	33	33	18	18
10	29	33	33	18	18
11	31	33	33	18	18
12	31	33	33	18	18

Continuous interference - 625 line systems - SECAM television systems
(Precision Offset)

Offset (multiples of 1/12 line frequency)	Frequency difference (MHz) (separation between wanted and unwanted carriers) Chrominance range				
	3.0	3.6	4.8	5.7	6.0
0	36	37	37	21	21
1	36	37	37	21	21
2	34	37	37	21	21
3	31	37	37	21	21
4	30	37	37	21	21
5	30	37	37	21	21
6	30	37	37	21	21
7	30	37	37	21	21
8	30	37	37	21	21
9	31	37	37	21	21
10	34	37	37	21	21
11	36	37	37	21	21
12	36	37	37	21	21

5. Protection Ratios for Image Channel Interference

625-line systems (UHF Bands)

Wanted Signal	Unwanted Signal G	H	I	D	K	K1	L	Image Channel
G	-1	-1	-4	-11	-11	-11	-7	n+9
H	-1	-1	-4	-9	-9	-9	-5	n+9
I	-13	-13	-10	-10	-10	-10	-6	n+9
D	13	13	13	13	13	13	15	n+9
K	13	13	13	13	13	13	15	n+9
D	-1	-1	-15	-12	-12	-12	-6	n+8
K	-1	-1	-15	-12	-12	-12	-6	n+8
K1	-1	-1	-4	-5	-5	-5	-1	n+9
K1	-1	-1	0	-2	-2	-2	+2	n-9
K1	7	7	7	7	7	7	9	n+10
L	-2	-2	-2	-4	-4	-13	-9	n-9
L	-20	-20	-20	-20	-20	-20	-20	n-8

6. Protection Ratio for wanted sound carriers
unwanted signal: CW or FM sound carrier

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

ANNEXURE - V

LIST OF PROGRAM MODULES

ANNEX-V

LIST OF PROGRAM MODULES

The package PLANTVFM consist of 24 modules. The main module is PLANTVFM. The other program modules in the package are as follows:

PLAN01 : 'LOGO' of the package
PLAN02 : Line Editor for editing data
PLAN03 : Computation of Δh values from terrain data
PLAN04 : Tabulation of radial details
PLAN05 : Tabulation of distances along different radials for a given field strength
PLAN06 : VHF/UHF Field Strength Curves (CCIR Rec.370-5)
PLAN07 : Tabulation of Δh values along different radials
PLAN08 : Computation of field strength between 10 & 800 km distances along different radials
PLAN09 : Graphic display of coverage area
PLAN10 : Graphic display of antenna gain pattern
PLAN11 : Graphic display of terrain map along a selected radial
PLAN12 : Program for selecting the list of transmitters within a choosen radius
PLAN13 : Program for the selection of transmitters for interference to sound broadcasting (Radio) services.
PLAN14 : Program for checking steady state and tropospheric interference for sound broadcasting service
PLAN14A: Program for drawing Emin and Eu curves
PLAN15 : Program for identifying various types of interference to TV service
PLAN16 : Program for calculating Esi values
PLAN17 : Program for checking steady state and tropospheric interference to find protection ratios
PLAN18 : Program for drawing Emin and Eu values for TV services
PLAN19 : Program for drawing Δh correction curves for standard Δh values
PLAN20 : Program for identifying interfering transmitters for calculating interference to sound carrier of TV service
PLAN21 : Program to draw Emin and Eu curves for interference to sound carrier of TV service.
PLAN22 : Program for tabulating antenna gain values along different radials

ANNEXURE-VI

LIST OF DATA FILES

LIST OF DATA FILES

The following data files are required to be created:

Transmitter Data File

TRANS.BSC : contains the basic data for all the transmitters.

Antenna Gain Pattern

The data files corresponding to nine antenna patterns already entered in the program are designated as follows:

TYPE1.ATG
TYPE2.ATG
TYPE3.ATG
TYPE4.ATG
TYPE5.ATG
TYPE6.ATG
TYPE7.ATG
TYPE8.ATG
TYPE9.ATG

The file TYPE0.ATG is blank and if needed data can be entered corresponding to any other gain pattern.

The Graphic adapters

ATT.BG1 : System files to detect Graphic adapters
CGA.BG1
EGAVGA.BG1
HERC.BG1
IBM8514.BG
PC3270.BG1

Font Files

GOTH.CHR : System files for getting various types of characters for display
LITT.CHR
SANS.CHR
TRIP.CHR

Protection Ratio

NPTAS.C1 : Protection Ratio Data Files
PTAS.C1
PTAT.C1

NPTAT.C1
PTAS.C2
NPTAS.C2
NPTAT.C2
PTAT.C2
NPTAS.S1
PTAS.S1
PTAT.S1
NPTAT.S1
PTAS.S2
NPTAS.S2
NPTAT.S2
PTAT.S2
PROT.DAT

Field Strength Curves Data

UHF_LAND.ONE : Field Strength Curve Data
UHF_LAND.FIV
UHF_LAND.TEN
UHF_LAND.FIF
UHF_CSEA.ONE
UHF_CSEA.FIV
UHF_CSEA.TEN
UHF_CSEA.FIF
UHF_WSEA.ONE
UHF_WSEA.FIV
UHF_WSEA.TEN
UHF_WSEA.FIF
VHF_LAND.ONE
VHF_LAND.FIV
VHF_LAND.TEN
VHF_LAND.FIF
VHF_CSEA.ONE
VHF_CSEA.FIV
VHF_CSEA.TEN
VHF_CSEA.FIF
VHF_WSEA.ONE
VHF_WSEA.FIV
VHF_WSEA.TEN
VHF_WSEA.FIF

Δh curves data

VHF_DELH.DAT : Δh correction factor data
UHF_DELH.DAT