Commission for
Communications Regulation

Technical Conditions

TECHNICAL CONDITIONS FOR THE OPERATION OF ANALOGUE PROGRAMME SERVICES DISTRIBUTION SYSTEMS IN THE FREQUENCY BAND 2500 – 2686 MHz

Document No:	**04/41**
Date:	**April 2004**

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1. PURPOSE

This document specifies the conditions attached to a licence issued under the Wireless Telegraphy (Multipoint Microwave Distribution System) Regulations 2003 (S.I. No.529 of 2003), made by the Commission for Communications Regulation for the possession and operation of a Multipoint Microwave Distribution System (MMDS) using the frequency band 2500 – 2686 MHz.

2. GENERAL

2.1 These conditions detail those characteristics of the equipment that need to be considered for the purposes of frequency spectrum management, safety and the provision of a satisfactory service to the subscriber and do not include detailed equipment specifications.

2.2 The technical parameters in this document are based on one-way operation.

2.3 The television standard permitted in this band shall be PAL System I with an 8MHz channel spacing. It shall be suitable for reception by a normal domestic TV receiver after suitable down conversion from the 2500–2686 MHz band and signal descrambling (if used).

2.4 Revision of the technical requirements specified in this document may be required from time to time.

2.5 Even though a system may satisfy the requirements specified in this document at the time of authorisation, the Commission, in accordance with the provisions of the Wireless Telegraphy (Multipoint Microwave Distribution System) Regulations 2003, may specify additional requirements for the system.

3. DEFINITIONS

For the purpose of this document the following definitions apply.

3.1 MMDS System

A Multipoint Microwave Distribution System (MMDS) is a fixed service system used for the retransmission of programmes on a point to multipoint basis.

3.2 Effective Antenna Height (EFF. HT.)

The effective height of a transmitting antenna is defined as its height in metres above the average level of the ground between distances of 3 and 15 km from the transmitter. This should be calculated for each of 18 evenly spaced radials (20 degree separation) starting from true North.

Note: This takes into account both the height of the site (a.s.l.) and the height of the mast (a.g.l.)

3.3 Omnidirectional Antenna

An omnidirectional antenna is an antenna having a horizontal radiation pattern with variations of 2 dB or less over 360 degrees.

3.4 Equivalent Isotropic Radiated Power (EIRP)

The Equivalent Isotropic Radiated Power (EIRP) is equal to the power supplied to the antenna multiplied by the isotropic gain of the antenna in a given direction.

3.5 Coverage Area

This is a geographical area within which the field strength is equal to or greater than the minimum field strength specified in Section 4.1 of this document.

3.6 The Commission

The Commission for Communications Regulation

4. SYSTEM PARAMETERS

Note: The system measurement point for Sections 4.2 and 4.3 is the point to which the television receiver socket (e.g. antenna socket) will be connected.

4.1 Minimum Field Strength

The minimum field strength for use in system planning is 66 dB (μV/m).

4.2 Equalisation

The difference between vision carrier levels of any two television channels shall not exceed 6 dB.

4.3 Signal - to - Noise Ratio and Distortion

4.3.1 The system design objective shall be set to achieve a system signal to noise ratio of 45 dB (RMS of peak signal to RMS noise unweighted).

4.3.2 The system design objective for cross modulation, defined as the ratio of the percentage modulation on a disturbing channel to that induced on an unmodulated wanted channel, shall be at least 46 dB.

4.3.3 Where second order intermodulation products are liable to fall in a channel the protection ratio shall be at least 60 dB.

5. TRANSMISSION CHARACTERISTICS

5.1 Limit on Effective Antenna Height

The transmitting antenna shall be limited to that height necessary to provide a line-of-sight path to the required coverage area. Heights above 200 metres will not normally be allowed except as special cases (see Section 5.3)

5.2 Limit on Equivalent Isotropic Radiated Power

In general, the EIRP shall be adjusted so as not to cause the field strength, at the edge of the Primary Cell as calculated by using Figure 1, to exceed 66 dB (μV/m) (- 80 dBW/m²). The maximum EIRP of the vision carrier for each channel must not exceed 32dBX in any direction.

5.3 Relaxation in special cases to the maximum EIRP and Maximum Effective Antenna Height

If the desired field strength is not obtained at the edge of the coverage area, the ODTR may consider a request to increase the EIRP and/or the EFF. HT. The maximum EIRP however must not exceed 32dBW at antenna height of 200 metres. Where a case is made for a height above 200 metres the maximum permissible EIRP (32 dB) shall be reduced by 1 dB for every 25 metres of height above 200 metres to a maximum reduction of 5 dB at the maximum permitted height of 325 metres.

Excessive transmitting antenna heights or EIRP proposed merely to provide coverage to a relatively few receiving stations which are not ideally located will, in general, not be permitted. Furthermore, antenna heights and EIRP in excess of the norm may only be permitted if they do not inhibit the development of the National Plan (See Section 7) or cause interference to other services in the same or adjacent bands.

5.4 Transmitting Antenna(s)

Depending on the transmitter location relative to its service area, omnidirectional or directional transmitting antennas will be used. The antenna(s) shall employ linear polarisation, using the vertical or horizontal component in accordance with the National Plan. (See Section 7) The emission in the plane that is orthogonal to the wanted polarisation shall be at least 22 dB below the wanted signal.

5.5 Transmitter

The transmitter shall meet the following minimum technical requirements.

5.5.1 Frequency Range of Operation

The transmitter will operate within the frequency band 2500 – 2686 MHz in accordance with Table 1.

5.5.2 Frequency Stability and Tolerance

To enable the use of frequency offset in the channelling plan, each carrier frequency shall be maintained to a tolerance of $\pm$500 Hz.

5.5.3 Frequency Offset

The transmitter shall operate with either no frequency offset or a frequency offset of one half of line frequency (i.e. 7.8125 kHz) with respect to the nominal vision and sound carrier frequencies.

5.5.4 Transmitter Spurious Emissions

The harmonics of the vision and sound carriers shall be attenuated at least 60 dB below the level of the vision peak power output. All other emissions appearing on frequencies outside its channel bandwidth, shall be attenuated at least 40 dB at the edges of the band falling linearly to 50 dB at frequency separation 0.5 MHz and 1.0 MHz beyond upper and lower band edges respectively and 50 dB thereafter, with the exception that the intermodulation products at $\pm$ 315 kHz and 2.87 MHz, with respect to the vision carrier shall be attenuated at least 46 dB. Where the transmit site is shared with or adjacent to a site of another radio service, the operator (of the programme retransmission system) may be required to take special measures so as to reduce the level of spurious emissions below the limits specified above.

5.5.5 Sound Carrier Level

The sound carrier level shall be between 7 to 10 dB below the level of its related vision peak carrier level.

5.5.6 Modulation

(a) Vision – The modulation of the visual carrier shall be vestigial sideband AM (C3F or if including data e.g. teletext then C9F) with the carrier nominally located 1.25 MHz above the lower edge of the channel.

(b) Sound – The modulation of the aural carrier shall be FM (F3E) with the centre frequency located 5.996 MHz ± 0.0005 MHz above the visual carrier frequency, using a frequency deviation of ± 50 kHz.

5.5.7 Where a number of channels are combined into a single antenna, it is recommended that all channels use a common frequency source for obtaining each channel frequency.

6. RECEIVER CHARACTERISTICS

6.1 Receiver Antenna Characteristics

The receiving antenna shall normally have the following minimum characteristics. (These are the characteristic values used in the development of the National Plan.)

Antenna gain	22dBi
Antenna front-to-back ratio:	20dB
Orthogonal polarisation discrimination	19 dB in the main beam and 6 dB at other azimuths

In areas with high wanted signal strength the licensee may install simpler receiving antennas provided the system parameters specified in section 4 are complied with.

6.2 Downconverter Characteristics

Noise Figure 6 dB

Output Impedance (75 ohms)
Output Level 60 dBμV (tolerance +12 dB –6 dB)

Permitted Output Frequency Ranges for Interfacing MMDS Receiving Equipment to Television Sets:-

Band I	47-68 MHz
Band III	174-230 MHz
Band IV/V	470-790 MHz (up to 862 MHz in some instances)

6.2.1 The downconverter output channels operating in the permitted frequency ranges given in 6.2 above shall not overlap the channels radiated by any RTE television transmitter within whose service area the MMDS system is located.

6.2.2 The receiving equipment interconnections shall use high quality double-screened cable of the tape and braid variety.

6.3 UHF/VHF By-Pass

Facilities must be provided (within the MMDS receiving system), by means of bypass switching or some similar arrangement, to allow a direct connection from the VHF/UHF antenna (receiving off-air signals) to the TV receiver.

6.4 Limits for Spurious Emissions of MMDS Receiving Equipment

The power of any spurious emissions shall not exceed 2nW in the range 100 kHz to 1 GHz. These limits shall apply to all equipment between the MMDS receive antenna and the television receiver input socket.

7. NATIONAL PLAN

7.1 Channelling Groups

The proposed channelling arrangements are detailed in Table 1. This consists of 22 channels in the band 2500 MHz to 2686 MHz subdivided into 2 separate groups of interleaved channels. Group A uses the odd numbered channels and Group B uses the even numbered channels. Different frequencies to those specified in Table 1 will not normally be permitted.

Each of the above combinations can be used with a vertically (V) or horizontally (H) polarised antenna. Accordingly 8 different combinations are available for use.

These are:

AH	BH
AH+	BH+
AV	BV
AV+	BV+

7.2 Primary Tier of National Plan

Map 1 and Table 2 detail the primary tier of the National Plan. This uses the following combinations, AH, BH, AV+ BV+. Combinations AH+, BH+, AV and BV are not used in the above-mentioned plan but may be used for fill-in stations. These fill-in stations will form the second tier of the National Plan.

The plan is based on Primary Cells with radii of between 10 and 30 miles (16 and 48 km). Terrain figures have been used as far as possible to form the outer limits of the Cells. (See Table 2 and Map 1, for details).

7.3 Modification to the plan

While the plan is based on transmitter stations using omnidirectional or near omnidirectional antennas sited at the centre of the Primary Cells (see grid reference in Table 2), licensees may, if they so wish, propose a different site using a directional antenna with a suitable radiation pattern to provide service in the proposed coverage area.

The licensee should determine the EIRP required servicing the proposed coverage area. (See Section 8.2) However it should be noted that the limit of 66 dBμV/m (-80 dBw/m²) specified in section 5.2 at the edge of the Primary Cells must not be exceeded.

7.4 Fill-in Stations

Due to terrain limitations, it may not in all cases be possible to service the entire area within each cell from one location. In such cases fill-in stations may be permitted. The proposed location and channel/polarisation/offset combination of such fill-in stations should be submitted to the Commission for consideration.

8. COVERAGE AREA PREDICTION

8.1 The coverage contour is a field strength level of 66 dB (μV/m) or a power flux density of -80 dBw/m². It should not extend beyond the line-of-sight distance to the horizon or beyond the edge of the Primary Cell. For receiving locations an unobstructed, line–of–sight propagation path between transmitting antenna and receiver is normally necessary.

The line-of-sight distance (D) in kilometres may be calculated from the following formula:

$$D = \sqrt{12.6H}$$

where H is the EFF. HT. in metres.

8.2 The EIRP and the antenna height should be selected such that the field strength at the most distant location does not exceed 66dB(μV/m). This can be determined using the field strength curve in figure 1. These curves are based on an inverse distance field strength and incorporate a 7dB grazing loss.

8.3 The calculation of the coverage is to be based on the EIRP and effective antenna height averaged over 3 to 15 km along each radial as defined in Section 3.2 that are within the proposed coverage area. For areas of very irregular terrain any obstruction beyond 15 km should be taken into consideration in determining limitations to the coverage area.

8.4 Where the signal is limited by an obstruction or by the horizon the location of that obstruction/the horizon shall be considered to form part of the 66dB(μV/m) coverage contour.

9. SHARING WITH AND PROTECTION OF OTHER SYSTEMS

9.1 Protection Criteria

9.1.1 The channels used shall be in accordance with those indicated in Tables 1 and 2. However additional channel requirements such as for fill-in stations, shall have to satisfy the technical criteria for protection to all other planned/assigned channels. The 66dB(μV/m) contour as specified in sections 8.1 and 8.4 shall be considered the protected contour.

Unless advised otherwise by the Commission it should be assumed that in the case of fill-in stations the 66dB(μV/m) protected contour shall not extend beyond the edge of the Primary Cells.

9.1.2 For co-channel stations and for first adjacent channel stations the required C/I ratio, as taken for a receiver at the protected contour of another station, is shown below:

Channel Relationship	No offset dB	Offset dB
Co-channel	45	27
Adjacent Channel	-6	-6

The permissible interfering field strength at the protected contour is calculated according to the equation in Section 9.2 for each pertinent direction, and the corresponding distance. For distances of 20 km or greater Fig. 2 can be used. For distances less than 20 km use Fig. 1. Special consideration should be given for areas of very irregular terrain.

9.1.3 Where a fill-in station is within the protected contour of another station, orthogonal polarisation should be used.

9.1.4 The minimum separation distances (excluding terrain shielding) for the permissible interfering signal as calculated from Section 9.2 are:

Channel Relationship	**Minimum Separation (km)**
Co-channel (same polarisation) no offset	134
Co-channel (same polarisation) offset	111
Co-channel (orthogonal polarisation) no offset	126
Co-channel (orthogonal polarisation) offset	104
Adjacent Channel (same polarisation)	58
Adjacent Channel (orthogonal polarisation)	54

The above values are for stations using an effective antenna height of 200 metres and a maximum EIRP of 32dBw.

Where stations use effective antenna heights and power much less than the maximum power and antenna heights permitted, the separation distance will be correspondingly less than that listed above and can be calculated in a similar manner.

9.1.5 For fill-in stations it may not be possible to provide protection at their protected contours, to the extent detailed above. For such stations licensees may have to accept some limitation to their coverage area.

9.2 Analysis of Protection Requirements

Typical protection analysis can be undertaken using the method detailed below:

Figure 3 shows the coverage areas (circles) of a protected station T1 and a proposed station T2 which do not overlap, (overlapping service areas may be similarly analysed).

For co-channel and first adjacent channel stations, the maximum permissible interfering field strength at the protected contour of another station shall be determined using the following equation:

$$Fu = 66 + GD + XPD + FOA - C/I$$

Where: Fu = unwanted interfering field strength
GD = receive antenna discrimination
= 20 dB for locations C1 and C2
= 0 dB for locations B1 and B2
XPD = orthogonal polarisation discrimination (when T1 and T2 use orthogonal

polarisation)
= 17 dB at locations B1 and B2
= 6 dB at locations C1 and C2

FOA = freq. Offset advantage
= 18 dB for 7.8125 kHz co-channel frequency difference
= 0 dB if T1 and T2 use adjacent channels

C/I = 45 dB for co-channel stations at T1 and T2
= - 6 dB for adjacent channel stations at T1 and T2

The distance corresponding to Fu is determined from the curves shown in Fig. 2 using the corresponding transmitting antenna height above the average terrain for each pertinent direction. For distances less than 20 km use Fig. 1.

10. SCRAMBLING

The use of scrambling is permitted. In considering a scrambling system the following points should be noted.

(i) A scrambled signal must not occupy a greater bandwidth than a PAL System I signal.

(ii) The output of the descrambler must be within the normal broadcast VHF or UHF Bands (See Section 6).

(iii) The output of the descrambler must be a PAL System I signal.

Details of the proposed system shall be submitted to the Commission for approval before installation.

11. CO-ORDINATION AND SHARING WITH OTHER RADIO SERVICES IN THE SAME AND IN ADJACENT BANDS

11.1 Co-ordination

Channel assignments in Ireland that are within approximately 80 km of the territorial boundary with Northern Ireland or within approximately 30 km of the east coast of Ireland may require co-ordination with the United Kingdom administration. Such co-ordination will be undertaken by the Commission in order to minimise the potential for interference between radio services in Ireland and those in the United Kingdom.

In considering sharing between the MMDS system and other services in the same or adjacent bands, reference will be made to the standard ITU-R sharing criteria as specified in the Radio Regulations or any relevant ETSI standard.

12. SAFETY AND WEATHER PROTECTION

12.1 Safety

An MMDS system shall be so designed, constructed and installed as to prevent danger arising, either in normal use or under fault conditions, to subscribers, to personnel

working on, or externally inspecting the system, or to any other person. Safety should be considered under the following headings:-

personnel protection against electric shock;
personnel protection against radiation;
personnel protection against physical injury;
protection against fire.

The system must comply with the following requirements:

I.S./EN 60215: 1990
Safety Requirements for Radio Transmitting Equipment

ENV 50166-2
Human exposure to electromagnetic fields
High frequency (10 kHz to 300 GHz)

These standards are available from the National Standards Authority of Ireland[1].

12.2 Weather Protection

All apparatus and cables exposed to weather, corrosive atmosphere or other adverse conditions shall be so constructed or protected as may be necessary to prevent danger or interference arising from such exposure.

[1]Please note that the standard ENV 50166-2 is a European Pre standard and shall be replaced by the respective European Standard when it becomes available.

Table 1
MMDS Channel Plan
Group A

Channel Number	**Channel Frequencies (MHz)**
1	**2500-2508***
3	**2516-2524***
5	2532-2540
7	2548-2556
9	2564-2572
11	2580-2588
13	2596-2604
15	2612-2620
17	2628-2636
19	2644-2652
21	2660-2668

Table 1 (Continued)
MMDS Channel Plan
Group B

Channel Number	Channel Frequencies (MHz)
2	**2508-2516***
4	2524-2532
6	2540-2548
8	2556-2564
10	2572-2580
12	2588-2596
14	2604-2612
16	2620-2628
18	2636-2644
20	2652-2660
22	**2668-2676***

*** These frequencies are not available from 1/01/2005 onwards**

Table 2

Details of Primary Cells

CELL NO.	CELL NAME	NATIONAL GRID REFERENCE	RANGE
1	Buncrana	C352 290	20
2	Dungloe	B736 075	15
3	Dunkineely	G727 714	15
4	Ballycroy	F815 117	20
5	Foxford	G282 027	20
6	Sligo	G713 299	15
7	Stradone	H582 049	15
8	Cavanagarvan	H634 266	10
9	Dundalk	J143 076	20
10	Curraghroe	M953 746	30
11	Mullingar	N476 548	15
12	Navan	N924 691	20
13	Galway	M260 272	30
14	Cloghan	N089 187	20
15	Kildare	N714 168	20
16	Howth	O283 377	20
17	Wicklow	T286 931	15
18	Ballybunnion	Q910 425	20
19	Limerick	R523 636	30
20	Boggan	S327 570	30
21	Nurney	S749 653	15
22	Gorey	T180 626	10
23	Kilcotty	T070 385	15
23a	Ballycanew	T093 498	20
24	Farranfore	Q952 004	15
25	Mallow	W623 980	20
26	Villierstown	X110 940	15
27	Cheekpoint	S681 128	20
28	Drinagh	W243 448	15
29	Cork Airport	W684 663	20

Note: (i) National Grid References quoted are for centres of cells.

(ii) Range quoted is in miles.

MMDS Geographical Cell Allocation

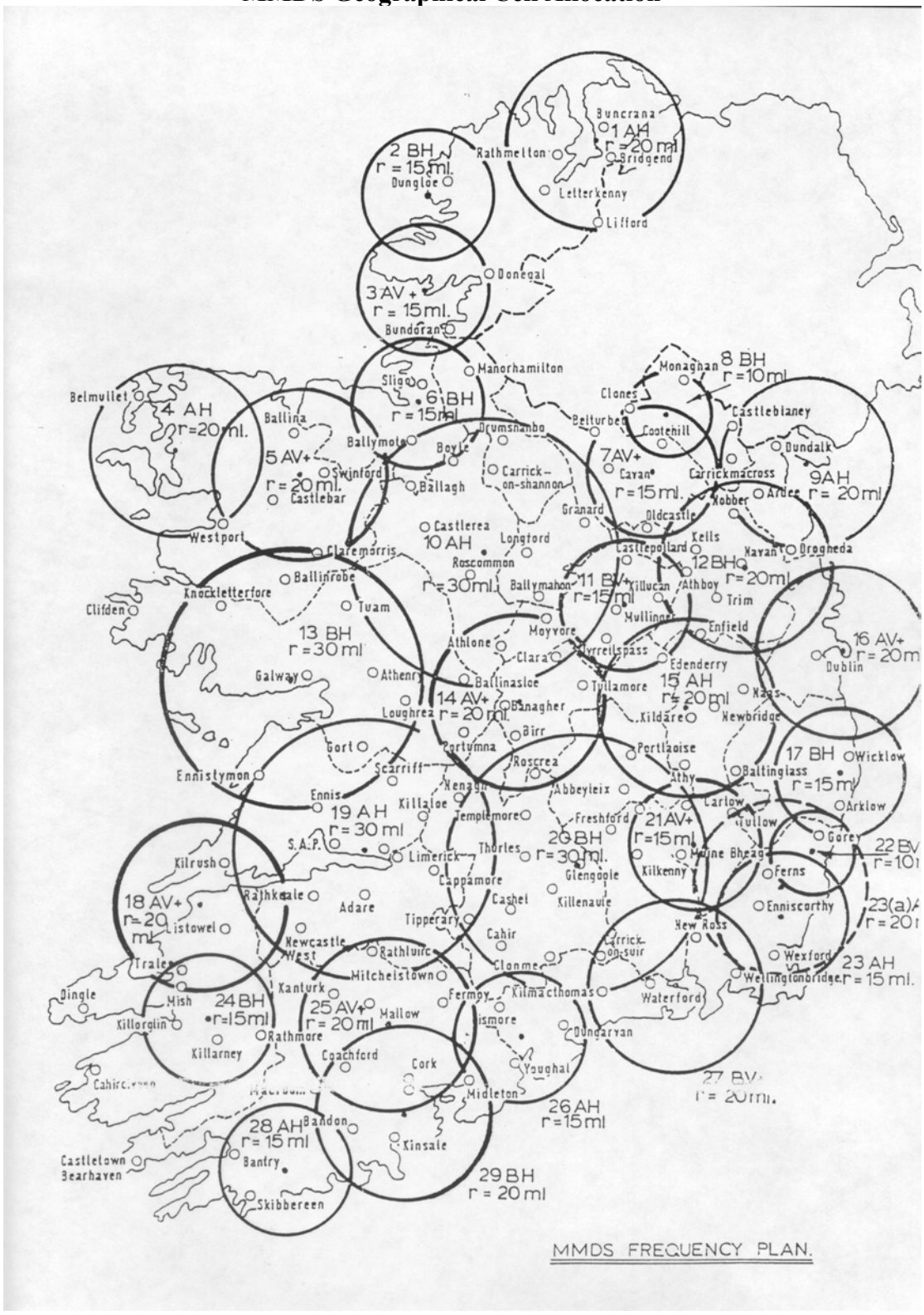


Fig. 1: 2.6 GHz Field Intensity Versus Distance for Various Transmitting Antenna Heights at an EIRP of 32 dBw

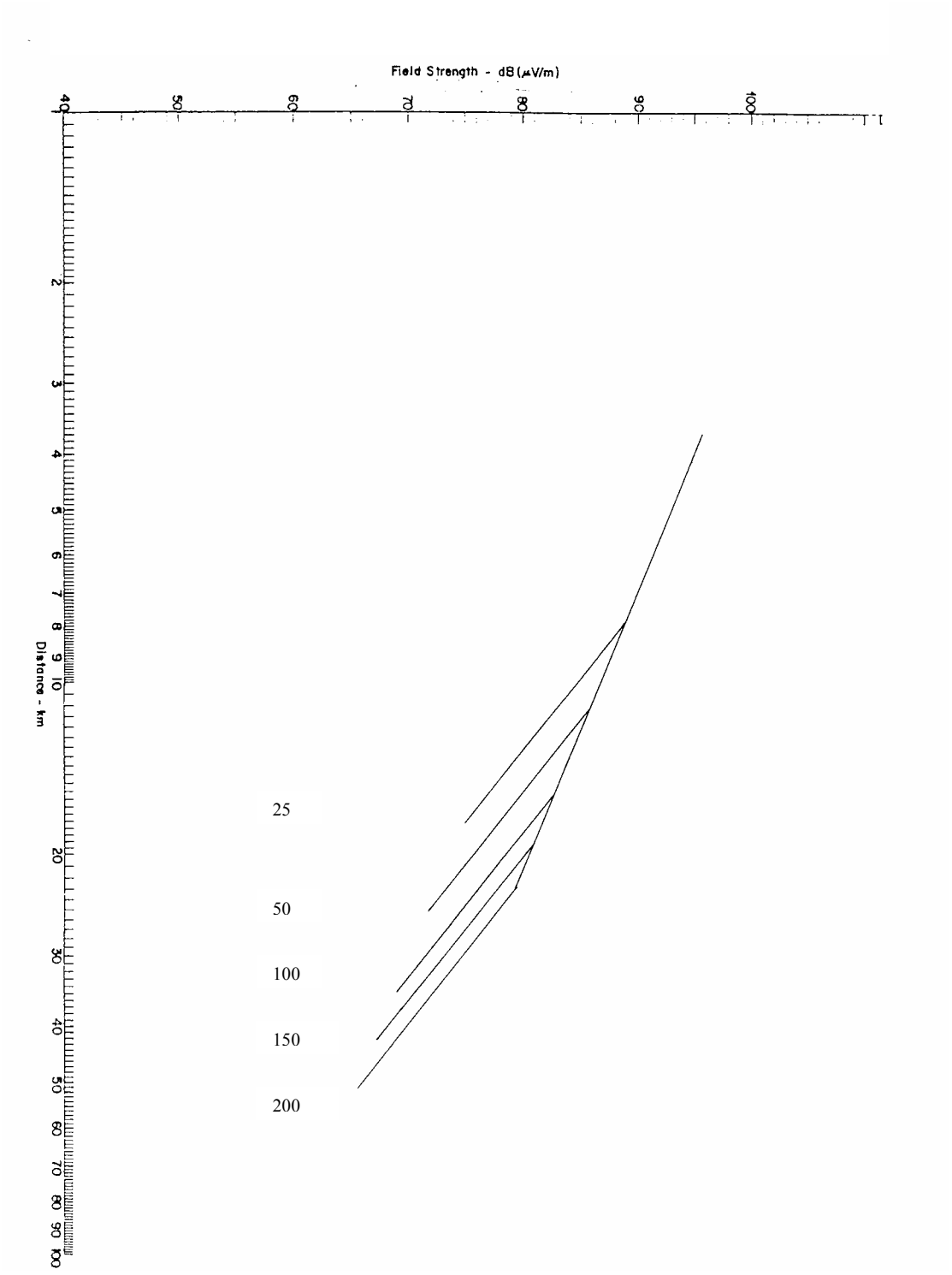
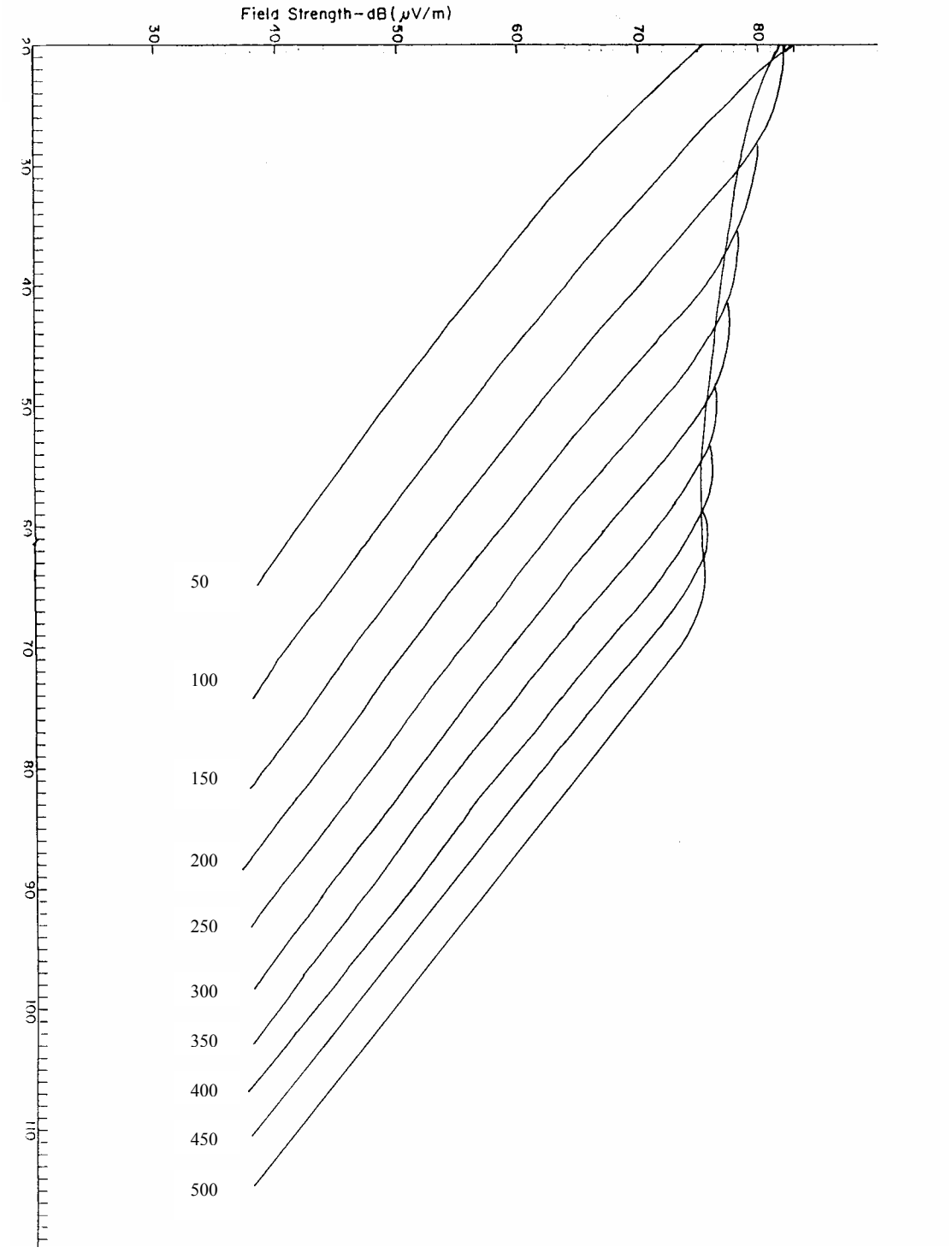


Fig. 2: 2.6 GHz Field Intensity Exceeded for 10% of the Time, Versus Distance for Various Heights of Transmitting antenna at an EIRP of 32dBW. (Receive Antenna Height 10m, Transmitting Antenna Heights in Metres, Distance in km)



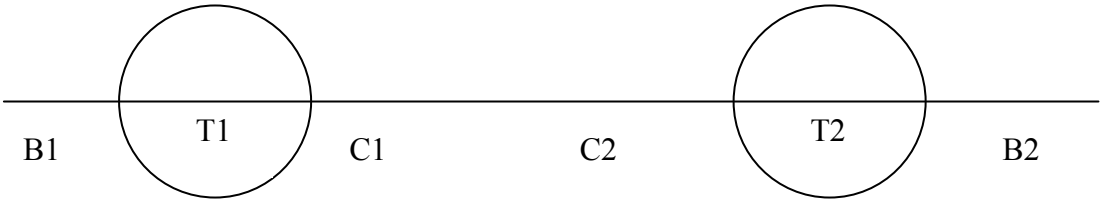


Fig.3