XVII A.P.
DÜSSELDORF
21.5-1.6 1990
CCIR

XVIIth PLENARY ASSEMBLY
DÜSSELDORF, 1990

INTERNATIONAL TELECOMMUNICATION UNION

RECOMMENDATIONS OF THE CCIR, 1990

(ALSO RESOLUTIONS AND OPINIONS)

VOLUMES X AND XI – PART 2

BROADCASTING-SATELLITE SERVICE (SOUND AND TELEVISION)

CCIR INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

Geneva, 1990

CCIR

1. The International Radio Consultative Committee (CCIR) is the permanent organ of the International Telecommunication Union responsible under the International Telecommunication Convention "... to study technical and operating questions relating specifically to radiocommunications without limit of frequency range, and to issue recommendations on them..." (International Telecommunication Convention, Nairobi 1982, First Part, Chapter I, Art. 11, No. 83).*

2. The objectives of the CCIR are in particular:

a) to provide the technical bases for use by administrative radio conferences and radiocommunication services for efficient utilization of the radio-frequency spectrum and the geostationary-satellite orbit, bearing in mind the needs of the various radio services;

b) to recommend performance standards for radio systems and technical arrangements which assure their effective and compatible interworking in international telecommunications;

c) to collect, exchange, analyze and disseminate technical information resulting from studies by the CCIR, and other information available, for the development, planning and operation of radio systems, including any necessary special measures required to facilitate the use of such information in developing countries.

* *See also the Constitution of the ITU, Nice, 1989, Chapter 1, Art. 11, No. 84.*

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92-61-04271-6

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PLAN OF VOLUMES I TO XV
XVIIth PLENARY ASSEMBLY OF THE CCIR

(Düsseldorf, 1990)

VOLUME I (Recommendations) *Annex to Vol. I* (Reports)	Spectrum utilization and monitoring
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All references within the texts to CCIR Recommendations, Reports, Resolutions, Opinions, Decisions and Questions refer to the 1990 edition, unless otherwise noted; i.e., only the basic number is shown.

Printed in Switzerland

DISTRIBUTION OF TEXTS OF THE XVIIth PLENARY ASSEMBLY OF THE CCIR IN VOLUMES I TO XV

Volumes and Annexes I to XV, XVIIth Plenary Assembly, contain all the valid texts of the CCIR and succeed those of the XVIth Plenary Assembly, Dubrovnik, 1986.

1. Recommendations, Resolutions, Opinions are given in Volumes I-XIV and Reports, Decisions in the Annexes to Volumes I-XII.

1.1 *Numbering of texts*

When a Recommendation, Report, Resolution or Opinion is modified, it retains its number to which is added a dash and a figure indicating how many revisions have been made. Within the text of Recommendations, Reports, Resolutions, Opinions and Decisions, however, reference is made only to the basic number (for example Recommendation 253). Such a reference should be interpreted as a reference to the latest version of the text, unless otherwise indicated.

The tables which follow show only the original numbering of the current texts, without any indication of successive modifications that may have occurred. For further information about this numbering scheme, please refer to Volume XIV.

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* Not reprinted, see Dubrovnik, 1986.

(1) Published separately.

1.3 *Reports (cont.)*

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* Not reprinted, see Dubrovnik, 1986.

(1) Published separately.

1.3.1 *Note concerning Reports*

The individual footnote “Adopted unanimously” has been dropped from each Report. Reports in Annexes to Volumes have been adopted unanimously except in cases where reservations have been made which will appear as individual footnotes.

1.4 *Resolutions*

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		70	IV-1	96, 97	X-1
27	I	71	VIII-3	98	X-1 + XII
42	XI-1	72	X-1 + XI-1	99	X-1
43	X/XI-2	76	IV-1 + X-1 + XI-1 + XII	100	I
51	X/XI-2			101	II
53, 54	I	77	XII	102	V
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57	VI	80	XI-1	105	XIV
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59	X/XI-3	83-86	VI		

2. Questions (Vols. XV-1, XV-2, XV-3, XV-4)

2.1 *Numbering of texts*

Questions are numbered in a different series for each Study Group: where applicable a dash and a figure added after the number of the Question indicate successive modifications. The number of a Question is completed by an *Arabic figure indicating the relevant Study Group.* For example:

– Question 1/10 would indicate a Question of Study Group 10 with its text in the original state;

– Question 1-1/10 would indicate a Question of Study Group 10, whose text has been once modified from the original; Question 1-2/10 would be a Question of Study Group 10, whose text has had two successive modifications.

Note – The numbers of the Questions of Study Groups 7, 9 and 12 start from 101. In the case of Study Groups 7 and 9, this was caused by the need to merge the Questions of former Study Groups 2 and 7 and Study Groups 3 and 9, respectively. In the case of Study Group 12, the renumbering was due to the requirement to transfer Questions from other Study Groups.

2.2 *Assignment of Questions*

In the plan shown on page II, the relevant Volume XV in which Questions of each Study Group can be found is indicated. A summary table of all Questions, with their titles, former and new numbers is to be found in Volume XIV.

2.3 *References to Questions*

As detailed in Resolution 109, the Plenary Assembly approved the Questions and assigned them to the Study Groups for consideration. The Plenary Assembly also decided to discontinue Study Programmes. Resolution 109 therefore identifies those Study Programmes which were approved for conversion into new Questions or for amalgamation with existing Questions. It should be noted that references to Questions and Study Programmes contained in the texts of Recommendations and Reports of Volumes I to XIII are still those which were in force during the study period 1986-1990.

Where appropriate, the Questions give references to the former Study Programmes or Questions from which they have been derived. New numbers have been given to those Questions which have been derived from Study Programmes or transferred to a different Study Group.

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VOLUMES X AND XI, PART 2

BROADCASTING-SATELLITE SERVICE
(SOUND AND TELEVISION)

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INTRODUCTION BY THE CHAIRMAN

1. Background and developments during the 1986-1990 study period

This Volume contains the results of studies of the broadcasting-satellite service made by Joint Working Group 10-11S. This Group has been entrusted by Study Groups 10 and 11 to conduct studies of all technical aspects of broadcasting from satellites for both sound and television.

During the 1986-1990 study period several satellite broadcasting systems for individual reception were launched for experimental purposes or as a prelude to operational systems. These are in addition to the satellite broadcasting systems already in operation in Japan. Notable among the new systems have been TDF-1 and TDF-2 of France, TV SAT of the Federal Republic of Germany, Tele-X of the Scandinavian countries, BSB of the United Kingdom and the Olympus satellite. The experience which will be gained from the operation of these satellites will be invaluable to the advancement of satellite broadcasting technology in the future, especially in reducing the size and cost of individual receivers. In addition to these systems, plans have been advanced in several countries for the introduction of satellite broadcasting systems in the near future. All these developments have been in accordance with the Plans and regulations established for the broadcasting-satellite service in the 12 GHz band in the Radio Regulations. On sound broadcasting from satellites, high quality satellite sound broadcasting using one TV channel in the 12 GHz Plan has been demonstrated, and a simulation of satellite sound broadcasting in the UHF band using advanced digital modulation has been successfully demonstrated on several occasions with reception by a whip antenna mounted on a car. Needless to say, the technology is rapidly advancing. At the same time, the reception of programmes broadcast from medium and low-power satellites directly to the homes has also been taking place in many countries.

A major administrative radio conference, WARC ORB-88, took place during this period. With appropriate preparations by JIWP 10-11/1 a feeder link Plan for Regions 1 and 3 was drawn up to match the downlink Plan prepared in 1977 for the 12 GHz band, and associated Radio Regulations were adopted. This completed the Plans for all Regions. As a result, the downlink satellite broadcasting Plans and associated regulations are included in Appendix 30 while the feeder link Plans and associated regulations for all Regions are now included in Appendix 30A. In addition, through the preparations of JIWP 10-11/1 and JIWP 10-11/3, Resolutions 520 and 521 were adopted at WARC ORB-88. Resolution 520 calls for a conference to allocate, if possible, a frequency band between 0.5 and 3 GHz for sound broadcasting from satellites to portable and vehicular receivers. Resolution 521 calls for the allocation of a frequency band between 12.7 and 23 GHz to be used for wide-RF band HDTV transmissions from satellites, while studying the future prospects of using wide-band HDTV in the 12 GHz band without prejudice to the Plans. The Plenipotentiary Conference, Nice 1989, in response to these Resolutions scheduled an allocation conference in 1992 to consider these allocations, among other tasks.

JIWP 10-11/3 has also been very active in developing studies on HDTV emissions from satellites. It updated Report 1075 on the subject and submitted a comprehensive report to the Extraordinary Meeting of Study Group 11 on HDTV which was held in Atlanta (USA) in May 1989. The conclusions of the Extraordinary Meeting contain information on satellite emissions of HDTV based primarily on input from JIWP 10-11/3.

Following is an outline of the major studies undertaken in 10-11S during the Interim and Final Meetings.

2. New texts

One new Recommendation, two new Reports, one new Decision and one Resolution were adopted:

New Recommendation 712 sets the standards for high quality sound/data for the broadcasting-satellite service in the 12 GHz band. It is supported by new Report 1228 which describes the characteristics of the systems.

The other new Report 1227 describes initial studies carried out on systems for the integrated service digital broadcasting (ISDB).

New Decision 93 addresses the work to be done in preparation for WARC-92.

The Resolution, which was eventually incorporated into the text of Decision 51, resolved that the CCIR Special Publication "Specifications of Transmission Systems for the Broadcasting-Satellite Service" be updated by JIWP 10-11/3 and that a revision or a supplement to the publication be published by 31 December 1990.

3. Updating of existing texts

3.1 *Terminology*

Recommendation 566 on terminology was updated to reflect the definitions adopted for feeder links in Regions 1 and 3 at WARC ORB-88.

3.2 *Systems*

Report 215 was revised extensively, by removing much of the old information in it and updating the remaining text. This task was done between the Interim and Final Meetings by an ad hoc group chaired by Mr. Y. Suzuki (Japan), and was further modified at the Final Meetings.

Reports 632, 953, 954 and 1073 were updated to reflect new information and results of new measurements.

Report 955 on satellite sound broadcasting to portable and vehicular receivers was updated mainly by adding information on power requirements for four frequency ranges, the addition of text on non-geostationary satellite orbits and on frequency, time and space diversity techniques.

Report 1074 includes now a description of the system characteristics of the E-7 network of the MAC-packet family.

Report 1075 on HDTV satellite broadcasting was revised by JIWP 10-11/3 and further modifications were made during the Final Meetings. The updates reflect the latest information on HDTV satellite broadcasting systems, equipment and the addition of three new narrow-RF-band systems. It also contains information on HDTV demonstrations which were carried out recently.

3.3 *Technology*

Report 473 on receiver technology was updated to reflect the latest developments in this field as a result of operational and experimental experience with smaller and more efficient receiving equipment.

Report 808 was revised to reflect the latest developments in space segment technology, and Report 810 contains new information which describes the characteristics of "flat-plate" earth receiving antennas.

3.4 *Planning*

Report 812 was extensively revised to delete outdated description of computer programs used in the development of the 12 GHz Plans. It is expected that this material will be replaced by a description of the updated software used by the IFRB.

Report 952 has also been extensively revised to reflect the feeder link planning elements for Regions 1 and 3 which were used to draw up the Plan at WARC ORB-88.

3.5 *Frequency sharing*

A new section was added to Report 631 dealing with sharing between radioastronomy and the broadcasting-satellite service around 22 GHz.

Report 634 has been revised to include new results of protection ratio measurements related to MAC-packet, HD-MAC and the MUSE systems.

Reports 807 and 809 have been updated by adding new information on spurious emissions and inter-regional sharing.

3.6 *Decisions*

Decision 51 on the terms of reference for JIWP 10-11/3 was revised, relative to satellite HDTV studies, to make it apply only to system characteristics. The sharing and frequency aspects of satellite HDTV were moved to JIWP 10-11/1 in addition to its terms of reference in Decision 43 concerning sound satellite broadcasting. The feeder link tasks, having been completed by JIWP 10-11/1, were removed from Decision 43. Both Decisions were also updated to make them responsive to the preparatory work necessary for WARC-92.

3.7 *Questions and Study Programmes*

There were no modifications to the existing Questions. Study Programmes 1A/10 and 11 on the use of the 12 GHz band was updated to make it responsive to progress in technology. Study Programme 1E/10 and 11 was updated by adding reference to the work necessary for WARC-92 on sharing studies of HDTV.

Study Programme 2K/10 and 11 on the system characteristics for sound satellite broadcasting was revised to include reference to the work required for WARC-92. The same was done for Study Programme 2M/10-11 relative to satellite HDTV.

As a result of the decisions of the XVIIth Plenary Assembly in reorganizing the work of the CCIR, all Study Programmes were converted to Questions.

4. **Coordination**

Recognizing the importance of coordination with other international technical organizations, Study Groups 10 and 11 approved the proposal from JWG 10-11S to appoint Mr. Y. Suzuki (Japan) to be its Rapporteur on the IEC Technical Committees in which he participates. It is expected that this action will facilitate the two-way flow of information between the IEC and 10-11S on subjects of mutual concern. Comments on IEC work that have been specifically referred to 10-11S have been prepared for dispatch to the IEC.

Notes to the Chairmen of Study Group CMV, Study Group 4 and Study Groups 5 and 9 were prepared commenting on matters of mutual concern regarding terminology and frequency sharing.

5. **Future work**

The most important work in the immediate future as far as Joint Working Group 10-11S is concerned, is to prepare for WARC-92 which, *inter alia*, will consider the question of frequency allocations for sound satellite broadcasting in the 0.5-3 GHz band and for satellite wide-RF-band HDTV between 12.7 and 23 GHz. The bulk of the work is entrusted to JIWP 10-11/1, chaired by Mr. D. Sauvet-Goichon (France), and JIWP 10-11/3, chaired by Mr. O. Mäkitalo (Sweden). The Chairman is confident that, with the text already existing in this Volume, plus the programme of work outlined for these two Groups, Study Groups 10 and 11 will be well prepared for WARC-92.

SECTION 10/11A: TERMINOLOGY

RECOMMENDATION 566-3 *

TERMINOLOGY RELATING TO THE USE OF SPACE COMMUNICATION TECHNIQUES FOR BROADCASTING

(1978-1982-1986-1990)

The CCIR

UNANIMOUSLY RECOMMENDS

that the following terminology should be used when referring to the use of space communication techniques for broadcasting:

1. Broadcasting-satellite service (Note 1)

1.1 A radiocommunication service in which signals transmitted or retransmitted by space stations are intended for direct reception (Note 2) by the general public.

Note 1 – See No. 37 of the Radio Regulations.

Note 2 – In the broadcasting-satellite service, the term "direct reception" shall encompass both individual reception and community reception. (See No. 37 of the Radio Regulations.)

1.2 *Broadcasting-satellite space station*

A space station in the broadcasting-satellite service, on an earth satellite.

1.3 *Methods of reception*

1.3.1 *Individual reception* (in the broadcasting-satellite service) (Note 3)

The reception of emissions from a space station in the broadcasting-satellite service by simple domestic installations and in particular those possessing small antennas.

Note 3 – See No. 123 of the Radio Regulations.

1.3.2 *Community reception* (in the broadcasting-satellite service) (Note 4)

The reception of emissions from a space station in the broadcasting-satellite service by receiving installations, which in some cases may be complex and have antennas larger than those used for individual reception, and intended for use:

– by a group of the general public at one location, or
– through a distribution system covering a limited area.

Note 4 – See No. 124 of the Radio Regulations.

1.4 *Reception quality*

1.4.1 *Primary grade of reception quality* (in the broadcasting-satellite service)

A quality of reception of emissions from a broadcasting-satellite space station which is subjectively comparable to that provided by a terrestrial broadcasting station in its coverage area **.

1.4.2 *Secondary grade of reception quality* (in the broadcasting-satellite service)

A quality of reception of emissions from a broadcasting-satellite space station which is subjectively inferior to the primary grade of reception quality but is still acceptable (see Report 409).

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

** The coverage area for a terrestrial television broadcasting station is given in Recommendation 417 in terms of the minimum field strength for which protection may be sought when planning a television service. In the case of sound broadcasting, Recommendation 638 defines the coverage area for the LF, MF and HF bands when amplitude modulation is used, while Recommendation 412 recommends the minimum usable field strengths for the VHF band when using frequency modulation techniques.

1.5 *Power flux-densities*

To permit individual or community reception with either grade of reception quality, broadcasting-satellite space stations may provide a high, medium or low power flux-density at the receiving site.

1.5.1 *High power flux-density* (in the broadcasting-satellite service)

A power flux-density which enables signals radiated by broadcasting-satellite space stations to be received by simple receiving installations with a primary grade of reception quality.

1.5.2 *Medium power flux-density* (in the broadcasting-satellite service)

A power flux-density which enables signals radiated by broadcasting-satellite space stations to be received either by simple receiving installations with a secondary grade of reception quality or by more sensitive receiving arrangements with a primary grade of reception quality.

1.5.3 *Low power flux-density* (in the broadcasting-satellite service)

A power flux-density lower than the medium power flux-density, which enables the necessary grade of reception quality to be obtained using more specialized transmission and reception techniques than those required under § 1.5.1 and 1.5.2.

2. Definitions concerning the use of the fixed-satellite service for the distribution of broadcasting programmes to terrestrial broadcasting stations

2.1 *Indirect distribution*

Use of the fixed-satellite service to relay broadcasting programmes from one or more points of origin to various earth stations for further distribution to the terrestrial broadcasting stations (possibly including other signals necessary for their operation).

2.2 *Direct distribution*

Use of the fixed-satellite service to relay broadcasting programmes from one or more points of origin directly to terrestrial broadcasting stations without any intermediate distribution stages (possibly including other signals necessary for their operation).

3. Definitions concerning the planning of the broadcasting-satellite service

3.1 *Service area*

The area on the surface of the Earth in which the Administration responsible for the service has the right to demand that the agreed protection conditions be provided.

Note – In the definition of service area, it is made clear that within the service area the agreed protection conditions can be demanded. This is the area where there should be at least the wanted power flux-density and protection against interference based on the agreed protection ratio for the agreed percentage of time should be achieved.

3.2 *Coverage area*

The area on the surface of the Earth delineated by a contour of a constant given value of power flux-density which would permit the wanted quality of reception in the absence of interference.

Note 1 – In accordance with the provisions of No. 2674 of the Radio Regulations, the coverage area must be the smallest area which encompasses the service area.

Note 2 – The coverage area, which will normally encompass the entire service area, will result from the intersection of the antenna beam (generally elliptical or circular) with the surface of the Earth, and will be defined by a given value of power flux-density. For example, in the case of a service planned for individual reception at 12 GHz, it would be the area delineated by the contour corresponding to a power flux-density level exceeded for 99% of the worst month of -103 dB(W/m^2) for a Region 1 and 3 country, and -107 dB(W/m^2) for a Region 2 country. There will usually be an area outside the service area but within the coverage area in which the power flux-density will be at least equivalent to the minimum specified value; however, protection against interference will not be provided in this area.

Note 3 – Non-classical beams (other than circular or elliptical) are finding increased use to cover large service areas. These are "shaped beams" whose cross-sections are designed to match as nearly as practicable the (generally irregular) boundaries of the service areas being covered. Such beams generally conform to the definition that the coverage area is delineated by the 3 dB contour of the antenna beam and where the power flux-density will be at least equivalent to the minimum required in the service area. In this case the coverage area and service area are more nearly the same than in the case of elliptical and circular beams. The power within the service/coverage area is more nearly uniform and is generally down by less than 3 dB at the edge of the service area. In some cases, the shaped beam may include one or more peaks within the service area in order to permit the use of smaller antennas or to provide higher rain margins in parts of the service area. It should be noted that Study Group 4 have adopted an Annex to Report 558 giving design objectives for shaped beam antennas.

3.3 *Beam area*

The area delineated by the intersection of the half-power beam of the satellite transmitting antenna with the surface of the Earth.

Note – The beam area is simply that area on the Earth's surface corresponding to the -3 dB points on the satellite antenna radiation pattern. In many cases the beam area would almost coincide with the coverage area, the discrepancy being accounted for by the permanent difference in path lengths from the satellite throughout the beam area, and also by the permanent variations, if any, in propagation factors across the area. However, in the case of 12 GHz, for a service area where the maximum dimension as seen from the satellite position is less than the minimum satellite antenna half-power beamwidth value adopted for planning purposes (0.6° for the Regions 1 and 3 Plan and 0.8° for the Region 2 Plan), there could be a significant difference between the beam area and the coverage area.

3.4 *Nominal orbital position*

The longitude of a position in the geostationary-satellite orbit associated with a frequency assignment to a space station in a space radiocommunication service. The position is given in degrees from the Greenwich meridian.

4. Definitions concerning the planning of broadcasting-satellite space stations and their feeder links

4.1 *Feeder link*

The term feeder link, as defined in No. 109 of the Radio Regulations, is further qualified to indicate a fixed-satellite service link from any earth station within the feeder-link service area to the associated space station in the broadcasting-satellite service.

4.2 *Feeder-link beam area*

The area delineated by the intersection of the half-power beam of the satellite receiving antenna with the surface of the Earth.

4.3 *Feeder-link service area*

The area on the surface of the Earth within the feeder-link beam area within which the administration responsible for the service has the right to locate transmitting earth stations for the purpose of providing feeder links to broadcasting-satellite space stations.

4.4 *Adjacent channel*

The RF channel in the broadcasting-satellite service frequency plan, or in the associated feeder-link frequency plan which is situated immediately higher or lower in frequency with respect to the reference channel as illustrated in Fig. 1.

4.5 *Second adjacent channel*

The RF channel in the broadcasting-satellite service frequency plan, or in the associated feeder-link frequency plan, which is situated immediately beyond either of the adjacent channels as illustrated in Fig. 1.

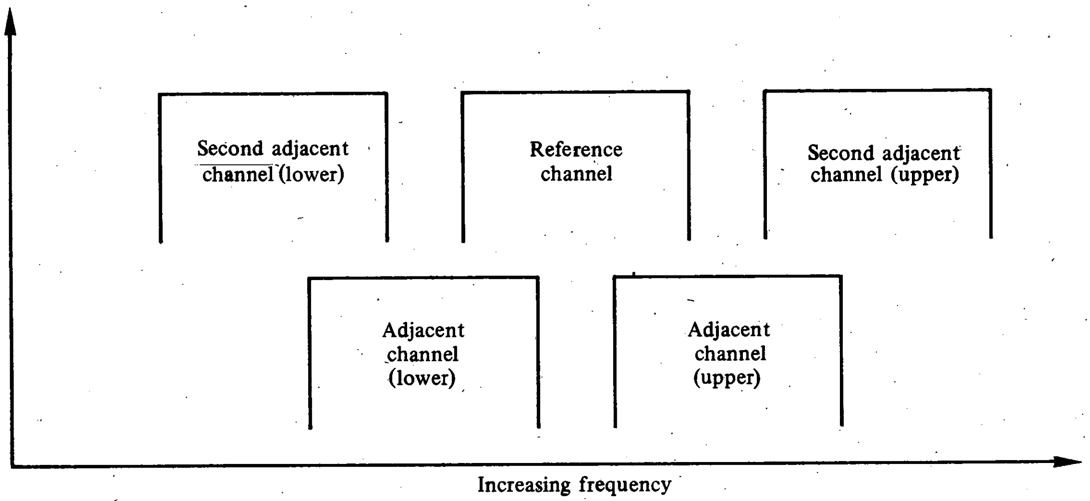

FIGURE 1 – *Channel designations in the case of overlapping frequency plans*

4.6 *Overall carrier-to-interference ratio*

The overall carrier-to-interference ratio is the ratio of the wanted carrier power to the sum of all interfering RF powers in a given channel including both feeder links and down links. The overall carrier-to-interference ratio due to interference from the given channel is calculated as the reciprocal of the sum of the reciprocals of the feeder-link carrier-to-interference ratio and the down-link carrier-to-interference ratio referred to the satellite receiver input and earth-station receiver input, respectively.

4.7 *Protection margin*

The protection margin is the difference in dB betweeen the carrier-to-interference ratio and the protection ratio (see RR 164). All powers are evaluated at the receiver input.

4.8 *Overall co-channel protection margin* (applicable to Region 2)

The overall co-channel protection margin in a given channel is the difference in dB betweeen the overall co-channel carrier-to-interference ratio and the co-channel protection ratio.

4.9 *Overall adjacent channel protection margin* (applicable to Region 2)

The overall adjacent channel protection margin is the difference, in dB, between the overall adjacent channel carrier-to-interference ratio and the adjacent channel protection ratio.

4.10 *Overall second adjacent channel protection margin* (applicable to Region 2)

The overall second adjacent channel protection margin is the difference, in dB, between the overall second adjacent channel carrier-to-interference ratio and the second adjacent channel protection ratio.

4.11 *Equivalent protection margin* (applicable to Regions 1 and 3)

The equivalent protection margin, M_c, for a channel, C, is given by the expression:

$$M_c = -10 \log \sum_{i=1}^{3} \left(10^{-M_i/10}\right) \quad \text{dB}$$

where:

M_1 : value (dB) of the protection margin (co-channel) for the wanted channel, C;

M_2, M_3 : values (dB) of the protection margins for the upper and lower adjacent channels respectively.

4.12 *Overall equivalent protection margin*

The overall equivalent protection margin, M, adopted by the RARC SAT-83 for the analyses of the Region 2 Plan, is given in dB by the expression:

$$M = -10 \log \left(\sum_{i=1}^{5} 10^{(-M_i/10)} \right) \quad \text{dB}$$

where:

M_1 : overall co-channel protection margin (dB) (as defined in § 4.7);

M_2, M_3 : overall adjacent channel protection margins for the upper and lower adjacent channels respectively (dB) (as defined in § 4.8);

M_4, M_5 : overall second adjacent channel protection margins for the upper and lower second adjacent channels respectively (dB) (as defined in § 4.9).

The adjective "equivalent" indicates that the protection margins for all interference sources from the adjacent and second adjacent channels as well as co-channel interference sources have been included.

The overall equivalent protection margin, M, adopted by the WARC ORB-88 for the analyses of the Regions 1 and 3 12 GHz band BSS Plan, is given in dB by the expression:

$$M = -10 \log \left(10^{-(M_u + R_{cu})/10} + 10^{-(M_d + R_{cd})/10}\right) - R_{co}$$

where:

M_u : equivalent protection margin for the feeder-link;

M_d : equivalent protection margin for the down-link;

R_{cu} : co-channel feeder-link protection ratio;

R_{cd} : co-channel down-link protection ratio;

R_{co} : co-channel overall protection ratio.

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SECTION 10/11B: SYSTEMS

RECOMMENDATION 650-1

TELEVISION STANDARDS FOR SATELLITE BROADCASTING IN THE CHANNELS DEFINED BY THE WARC BS-77 AND THE RARC SAT-83

(Question 2/10 and 11 and Study Programme 2F/10 and 11)

(1986–1990)

The CCIR,

CONSIDERING

(a) that the introduction of the broadcasting-satellite service offers the possibility of reducing the disparity between television standards throughout the world;

(b) that this introduction also provides an opportunity, through technological developments, for improving the quality and increasing the quantity and diversity of the services offered to the public; additionally, it is possible to take advantage of new technology to introduce time-division multiplex systems in which the high degree of commonality can lead to economic multi-standard receivers;

(c) that it will no doubt be necessary to retain 625-line and 525-line television systems;

(d) that broadcasting-satellite services using analogue composite coding according to Report 624 for the vision signal are being introduced;

(e) that it is generally intended that broadcasting-satellite standards should facilitate the maximum utilization of existing terrestrial equipment, especially that which concerns individual and community reception media (receivers, cable, re-broadcasting methods of distribution etc.). For this purpose a unique baseband signal which is common to the satellite-broadcasting system and the terrestrial distribution network is desirable;

(f) that the requirements as regards sensitivity to interference of the systems that can be used were defined by the WARC BS-77 for Regions 1 and 3 and by the RARC SAT-83 for Region 2;

(g) that complete compatibility with existing receivers is in any event not possible for frequency-modulated satellite broadcasting transmissions;

(h) that, as far as the video signal is concerned:

– the basis for the transmission of separate components has been established as an important principle by the CCIR in Recommendation 601;
– studios using component vision signals will produce pictures of higher quality than present-day studios using composite signals;
– the picture quality with present composite standards is limited by cross luminance/chrominance effects resulting from the band-sharing of luminance and chrominance signals;
– new technologies are available for receiver design which permits a new approach using separate colour components that are time-compressed and transmitted in time-division multiplex;
– a separate component approach allows scope for future enhancements of picture quality;

(j) that as far as the sound channels and the data services accompanying the television picture are concerned:

– according to CONSIDERING *(m)* of Decision 51-2, technical developments permit the use of digital techniques to be envisaged;
– the use of digital coding permits a large improvement in sound quality to be obtained;
– it is important to select for adoption, from the systems described in Report 632, that which offers the greatest possible capacity whilst making the best possible use of the radio-frequency channels defined by the WARC BS-77 and the RARC SAT-83, taking into account, if necessary, CONSIDERING *(e)* above;
– the principle of time multiplexing of sound and digital data, on the one hand, and the picture signal, on the other hand, eliminates the problems of intermodulation between the signals;

(k) that as far as the multiplexing of the audio signals and the data signals corresponding to the television auxiliary services defined in Report 802 is concerned:

– it is important to make the best possible use of the capacity offered by the digital modulation system;

– it is desirable to use the coding standards for digital audio channels proposed in Report 953 and to be able to associate with this baseband coding several levels of error protection, in order that it may be adapted to suit the particular requirements of the administrations;

– it is important to ensure maximum flexibility in the multiplexing process, which is to be selected from those whose principles are described in Report 954, in order that the particular requirements of the administrations may be met for the sharing of the available capacity between audio services and data services, to permit this sharing to be modified in time, and to allow the later introduction of new services that are not yet identified;

(l) that the ruggedness of the system should be such as to provide a service down to the lowest possible carrier-to-noise ratio,

UNANIMOUSLY RECOMMENDS

that when a broadcasting-satellite service is introduced in the 12 GHz band channels defined by the WARC BS-77 and the RARC SAT-83, the preferred systems for television services using 625-line and 525-line (see Note 1) standards should be:

– the systems using multiplex analogue components according to Report 1073 (see Note 2);

– the systems using analogue composite coding for the vision signal as described in Report 1073 or according to Report 624, or for certain administrations in Region 2, variations thereof.

Note 1 – The issue of the transmission signal format for the broadcasting-satellite service is still under consideration in both Canada and the United States of America. Two types, a component television system (B-MAC 525-line as described in Report 1073) and several composite television systems based on the NTSC baseband vision signal format, are included in these considerations.

Note 2 – For a number of administrations in Region 1 (those administrations of countries which have active members of the EBU) on member of the MAC/packet family (i.e. C, D, D2) should be used.

RECOMMENDATION 651

DIGITAL PCM CODING FOR THE EMISSION OF HIGH-QUALITY SOUND SIGNALS IN SATELLITE BROADCASTING (15 kHz NOMINAL BANDWIDTH)

(Question 2/10 and 11, Study Programme 2F/10 and 11)

(1986)

The CCIR,

CONSIDERING

(a) that the compromise between quality objectives and bit rate may be different for sound services which may have various quality requirements and planning constraints; they may also vary according to the requirements of individual administrations;

(b) that there are clear advantages for broadcasters, receiver manufacturers and the public in using a single standard for each application,

UNANIMOUSLY RECOMMENDS

1. that where PCM coding is employed (see Note 1), the sampling frequency should be 32 kHz for the emission of audio digital signals in satellite broadcasting having a 15 kHz nominal bandwidth;

2. that when a reduction in bit rate is necessary (see Note 2), a non-linear coding law should be used with near-instantaneous companding to reduce the number of bits/sample from 14 to 10. The companding law should have five scale ranges. The selected range is associated with a block of 32 consecutive samples. The pre-emphasis should conform either to CCITT Recommendation J.17 with an insertion loss of 6.5 dB at 0.8 kHz or to a 50/15 µs pre-emphasis, both shown in Fig. 1 (see Note 3);

3. that when the above bit-rate reduction is not necessary (see Note 2), linear coding should be used with 14 bits/sample, with pre-emphasis as in § 2 above, or, if judged to be needed, a 16-14 bits/sample floating-point system (see Note 4);

4. that in both cases (§ 2 and 3 above), 2s complement coding should be used (see Note 5).

Note 1 – Report 953 describes an alternative system of digital coding suitable for high quality sound signals for satellite sound broadcasting employing adaptive delta modulation.

Note 2 – The area of application for this case is related to national requirements.

Note 3 – In Region 1, the use of the pre-emphasis given in CCITT Recommendation J.17 is preferred.

Note 4 – For the case of sound-only broadcasting, studies are still in progress on the subject of emphasis for linear coding.

Note 5 – In both of the above cases (§ 2 and 3 above), the number of bits/sample does not include ancillary bits: for example, error-protection bits, or scale factor bits.

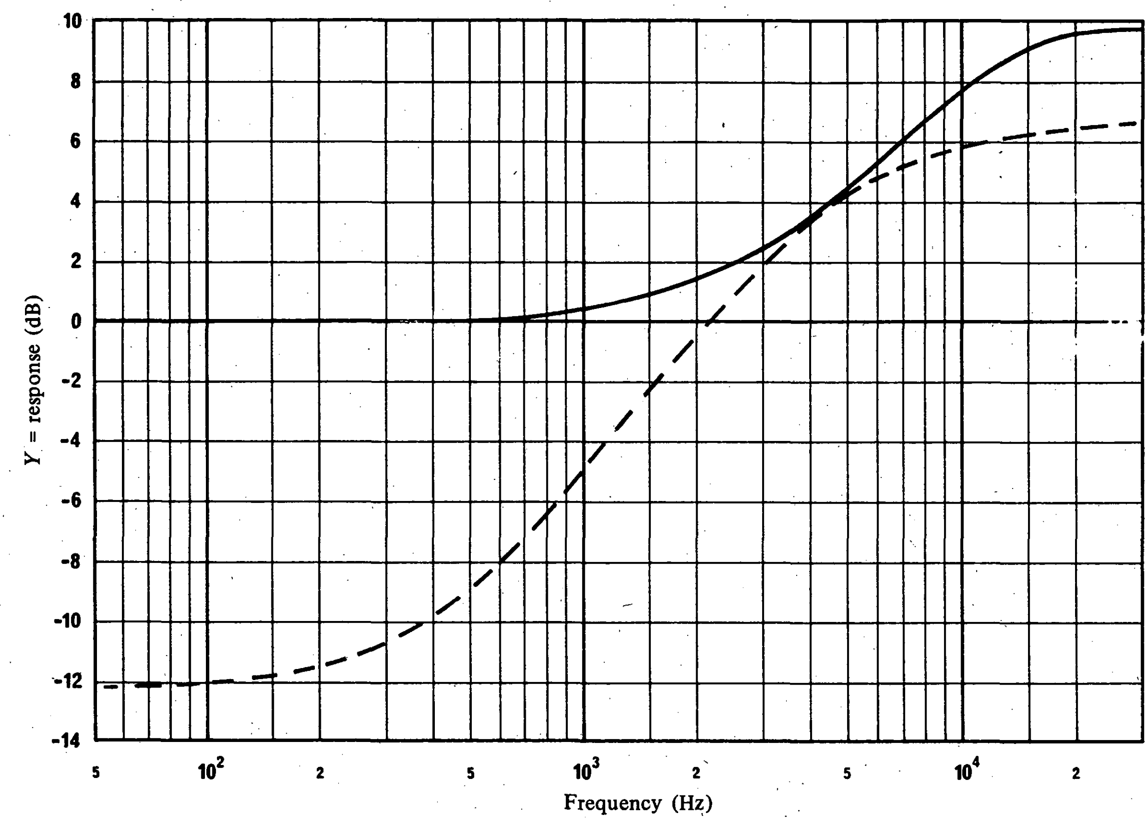

FIGURE 1 – *Pre-emphasis characteristics*

Note – Curves correspond to the following formulae:

——— For 50/15 μs ; $Y = 10 \log \dfrac{1 + (0.05\ \omega)^2}{1 + (0.015\ \omega)^2}$ dB

— — – For CCITT Recommendation J.17; $Y = 10 \log \dfrac{1 + \left(\dfrac{\omega}{3}\right)^2}{75 + \left(\dfrac{\omega}{3}\right)^2}$ dB*

where : $\dfrac{\omega}{2\pi}$: frequency (kHz)

* Attenuation of the pre-emphasis at 800 Hz is set to 6.5 dB.

RECOMMENDATION 712

HIGH-QUALITY SOUND/DATA STANDARDS FOR THE BROADCASTING-SATELLITE SERVICE IN THE 12 GHz BAND

(Question 1/10 and 11, Study Programme 1A/10 and 11)

(1990)

The CCIR,

CONSIDERING

(a) the needs expressed for the future development of satellite broadcasting both in the field of simultaneous transmission of a series of radio programmes of a very high technical quality and in the field of high-capacity data services;

(b) the technical performance of the DSR (Digital Satellite Radio) system which allows the transmission, in a channel of the 12 GHz band, of 16 stereophonic programmes of very high quality with maximum ruggedness against transmission errors;

(c) the definition of the digital full-channel mode of operation of systems of the MAC/packet family which allows for flexible multiplexing (20 Mbit/s for systems C and D, 10 Mbit/s for the D2 system) of sound programmes of high quality as well as any type of data;

(d) that both the MAC/packet system and the DSR system are intended for use via broadcasting satellites to fixed receivers;

(e) that other systems are being developed for sound broadcasting at UHF to fixed, portable and especially to mobile receivers,

UNANIMOUSLY RECOMMENDS

that when a sound/data broadcasting-satellite service to fixed receivers is introduced in the 12 GHz band in Region 1 the preferred systems should be (see Notes 1 and 2):

- the DSR system when the predominant consideration is the transmission of a number of very high-quality sound programmes within a wide coverage area;
- the full-channel digital mode of one of the systems of the MAC/packet family when the predominant consideration is the flexibility required for simultaneous transmission of high-quality sound programmes and high capacity data services.

Note 1 – The issue of a sound/data standard for the broadcasting-satellite service is still under consideration in Regions 2 and 3.

Note 2 – Detailed system descriptions are given in the Annexes to Report 1228.

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SECTION 10/11C: TECHNOLOGY

RECOMMENDATION 652

12 GHz RECEIVING EARTH-STATION ANTENNA AND SATELLITE TRANSMITTING ANTENNA REFERENCE PATTERNS FOR THE BROADCASTING-SATELLITE SERVICE

(Question 2/10 and 11 and Study Programme 2D/10 and 11)

(1986)

The CCIR,

CONSIDERING

(a) that for broadcasting-satellite service planning purposes, simple antenna reference patterns are necessary;

(b) that for reasons of cost, aesthetics, and ease of installation, antennas for individual reception should be small, simple, and amenable to mass-production techniques, and that within these general guidelines different design options should be possible;

(c) that planning for the broadcasting-satellite service based on individual reception in frequency bands around 12 GHz has taken place and community reception may also be accommodated;

(d) that easily applied antenna reference patterns are desirable to determine the levels of inter-regional interference;

(e) that every effort should be made to avoid unnecessary spill-over into adjacent service areas;

(f) that for the assessment of mutual interference between the 12 GHz broadcasting-satellite service and other services sharing the same frequency bands, it may be necessary to use a reference radiation pattern for both the earth-station receiving antenna and the satellite transmitting antenna;

(g) that the use of antennas with the best achievable radiation pattern will lead to the most efficient use of the radio-frequency spectrum and the geostationary-satellite orbit, and;

(h) that measured data relating to radiation patterns of 12 GHz broadcasting-satellite earth-station receiving antennas and satellite transmitting antennas are presented in Report 810;

UNANIMOUSLY RECOMMENDS

1. that for earth-station receiving antennas, to ensure that interference up to the limit of the service area should not exceed that envisaged in Plans for the 12 GHz band:

1.1 in Regions 1 and 3 individual reception receiving antennas should have co-polar and cross-polar radiation patterns not exceeding the reference patterns given in Fig. 1 by curves A and B respectively, taking $\varphi_0 = 2°$ (nominal half-power beamwidth);

1.2 in Region 2, individual reception receiving antennas should have co-polar and cross-polar radiation patterns not exceeding the reference patterns given in Fig. 2 by curves A and B respectively, taking $\varphi_0 = 1.7°$ (nominal half-power beamwidth);

1.3 in Regions 1 and 3 community reception receiving antennas should have co-polar and cross-polar radiation patterns not exceeding the reference pattern given in Fig. 1 by curves A′ and B respectively taking $\varphi_0 = 1°$ (nominal half-power beamwidth);

2. that for satellite transmitting antenna beams with circular or elliptical cross-section:

2.1 in Regions 1 and 3 the radiation pattern should conform to the applicable reference patterns given in Fig. 3;

2.2 in Region 2 the radiation pattern for normal roll-off should conform as a minimum requirement to the applicable reference pattern given in Fig. 4 and, for fast roll-off (see Note) to the reference pattern given in Fig. 5.

Note. – In Region 2, when necessary to reduce interference, the pattern shown in Fig. 5 was used to develop the Plan; this use is indicated in the Plan by an appropriate symbol. This pattern is derived from an antenna producing an elliptical beam with fast roll-off in the main lobe. Three curves for different values of φ_0 are shown as examples.

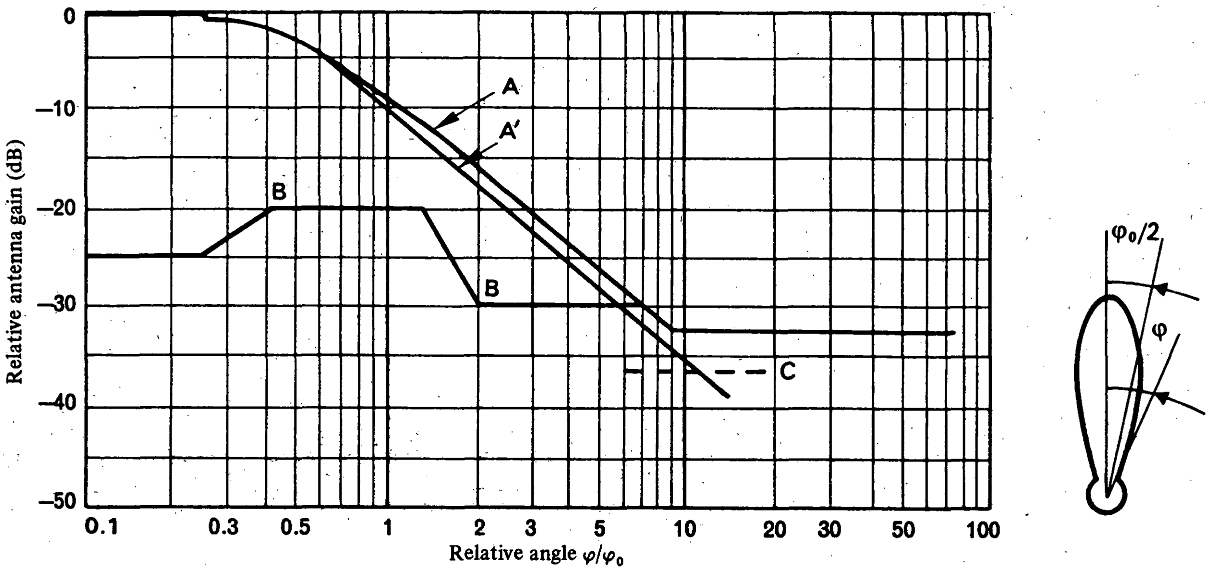

FIGURE 1 – *Co-polar and cross-polar receiving earth-station antenna reference patterns in Regions 1 and 3*

Curve A: co-polar component for individual reception without side-lobe suppression (dB relative to main beam gain)

0	for $0 \leq \varphi \leq 0.25\ \varphi_0$
$-12\left(\frac{\varphi}{\varphi_0}\right)^2$	for $0.25\ \varphi_0 < \varphi \leq 0.707\ \varphi_0$
$-\left[9.0 + 20\log\left(\frac{\varphi}{\varphi_0}\right)\right]$	for $0.707\ \varphi_0 < \varphi \leq 1.26\ \varphi_0$
$-\left[8.5 + 20\log\left(\frac{\varphi}{\varphi_0}\right)\right]$	for $1.26\ \varphi_0 < \varphi \leq 9.55\ \varphi_0$
-33	for $\varphi > 9.55\ \varphi_0$

Curve A': Co-polar component for community reception without side-lobe suppression (dB relative to main beam gain)

0	for $0 \leq \varphi \leq 0.25\ \varphi_0$
$-12\left(\frac{\varphi}{\varphi_0}\right)^2$	for $0.25\ \varphi_0 < \varphi \leq 0.86\ \varphi_0$
$-\left[10.5 + 25\log\left(\frac{\varphi}{\varphi_0}\right)\right]$	for $\varphi > 0.86\ \varphi_0$ up to intersection with Curve C (then Curve C)

Curve B: Cross-polar component for both types of reception (dB relative to main beam gain)

-25	for $0 \leq \varphi \leq 0.25\ \varphi_0$
$-\left(30 + 40\log\left\lvert\frac{\varphi}{\varphi_0} - 1\right\rvert\right)$	for $0.25\ \varphi_0 < \varphi \leq 0.44\ \varphi_0$
-20	for $0.44\ \varphi_0 < \varphi \leq 1.4\ \varphi_0$
$-\left(30 + 25\log\left\lvert\frac{\varphi}{\varphi_0} - 1\right\rvert\right)$	for $1.4\ \varphi_0 < \varphi \leq 2\ \varphi_0$

-30 until intersection with co-polar component curve; then co-polar component curve.

Curve C: Minus the on-axis gain (curve C in this figure illustrates the particular case of an antenna with an on-axis gain of 37 dBi).

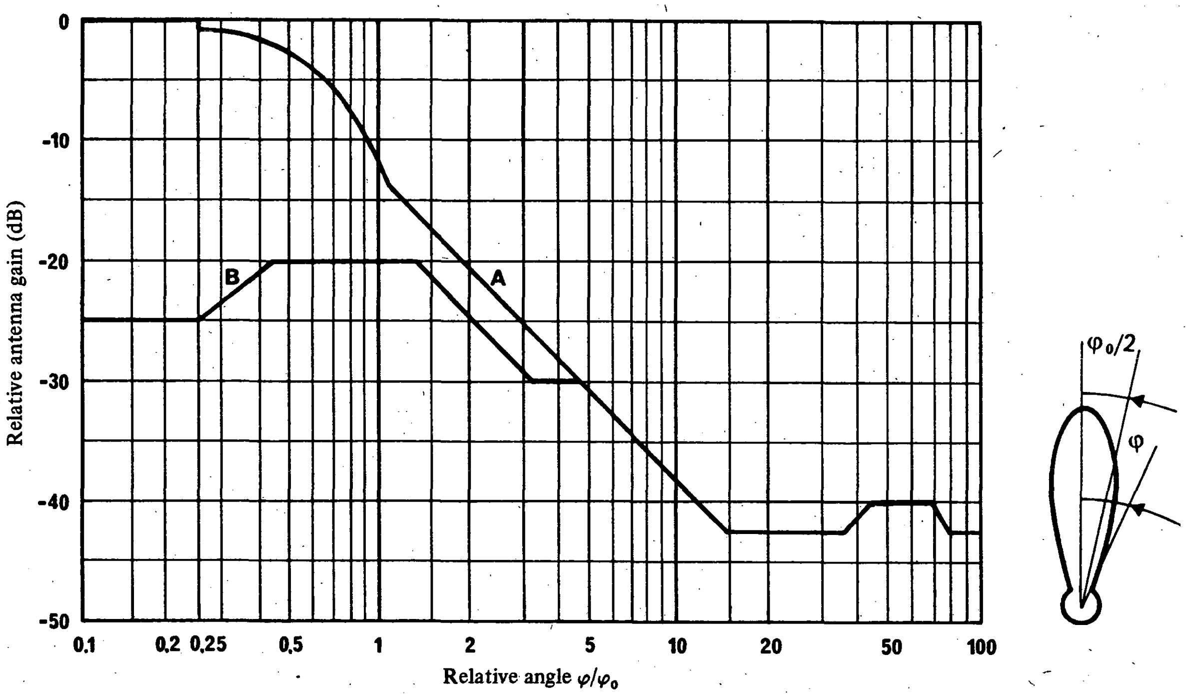

FIGURE 2 – *Reference patterns for co-polar and cross-polar components for receiving earth-station antennas in Region 2*

Curve A: Co-polar component without side-lobe suppression (dB relative to main beam gain)

0	for $0 \leqslant \varphi \leqslant 0.25\ \varphi_0$
$-12\ (\varphi/\varphi_0)^2$	for $0.25\ \varphi_0 < \varphi \leqslant 1.13\ \varphi_0$
$-[14 + 25 \log (\varphi/\varphi_0)]$	for $1.13\ \varphi_0 < \varphi \leqslant 14.7\ \varphi_0$
-43.2	for $14.7\ \varphi_0 < \varphi \leqslant 35\ \varphi_0$
$-[85.2 - 27.2 \log (\varphi/\varphi_0)]$	for $35\ \varphi_0 < \varphi \leqslant 45.1\ \varphi_0$
-40.2	for $45.1\ \varphi_0 < \varphi \leqslant 70\ \varphi_0$
$-[-55.2 + 51.7 \log (\varphi/\varphi_0)]$	for $70\ \varphi_0 < \varphi \leqslant 80\ \varphi_0$
-43.2	for $80\ \varphi_0 < \varphi \leqslant 180°$

Curve B: Cross-polar component (dB relative to main beam gain)

-25	for $0 \leqslant \varphi \leqslant 0.25\ \varphi_0$
$-\left(30 + 40 \log \left\| \frac{\varphi}{\varphi_0} - 1 \right\|\right)$	for $0.25\ \varphi_0 < \varphi \leqslant 0.44\ \varphi_0$
-20	for $0.44\ \varphi_0 < \varphi \leqslant 1.28\ \varphi_0$
$-\left(17.3 + 25 \log \left\| \frac{\varphi}{\varphi_0} \right\|\right)$	for $1.28\ \varphi_0 < \varphi \leqslant 3.22\ \varphi_0$

-30 until intersection with co-polar component curve; then co-polar component curve

Note 1 — In the angular range between $0.1\ \varphi_0$ and $1.13\ \varphi_0$ the co-polar and cross-polar gains must not exceed the reference patterns.

Note 2 — At off-axis angles larger than $1.13\ \varphi_0$ and for 90% of all side-lobe peaks in each of the reference angular windows, the gain must not exceed the reference patterns. The reference angular windows are $1.13\ \varphi_0$ to $3\ \varphi_0$, $3\ \varphi_0$ to $6\ \varphi_0$, $6\ \varphi_0$ to $10\ \varphi_0$, $10\ \varphi_0$ to $20\ \varphi_0$, $20\ \varphi_0$ to $40\ \varphi_0$, $40\ \varphi_0$ to $75\ \varphi_0$ and $75\ \varphi_0$ to $180°$.

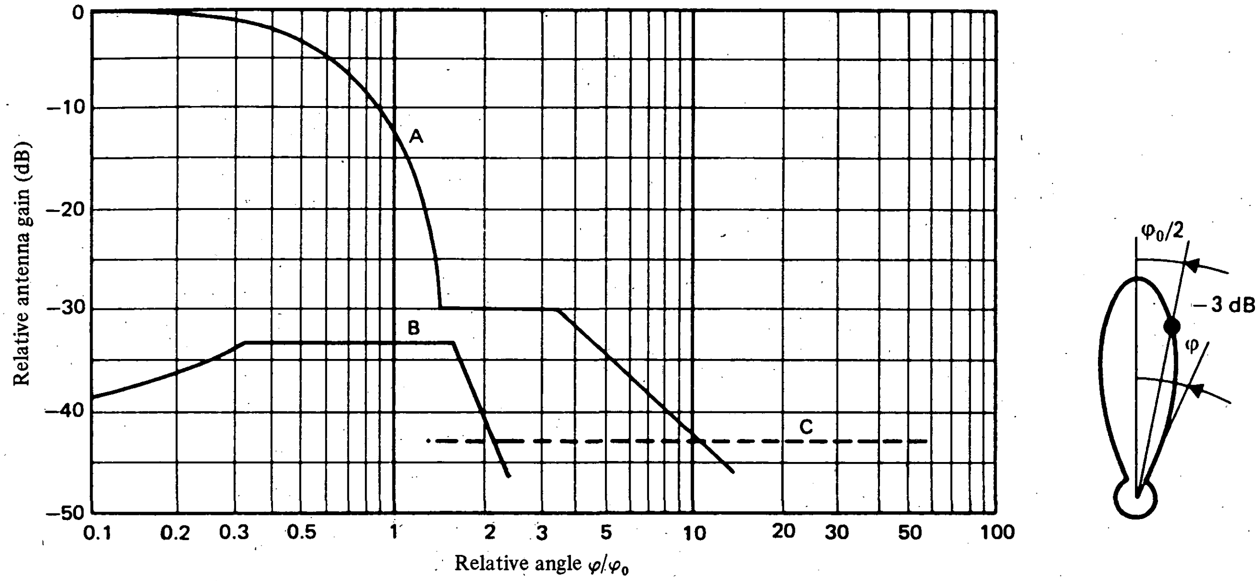

FIGURE 3 – *Reference patterns for co-polar and cross-polar components for satellite transmitting antennas in Regions 1 and 3*

Curve A: Co-polar component (dB relative to main beam gain)

$$-12\left(\frac{\varphi}{\varphi_0}\right)^2 \qquad \text{for } 0 \leqslant \varphi \leqslant 1.58\,\varphi_0$$

$$-30 \qquad \text{for } 1.58\,\varphi_0 < \varphi \leqslant 3.16\,\varphi_0$$

$$-\left[17.5 + 25\log\left(\frac{\varphi}{\varphi_0}\right)\right] \qquad \text{for } \varphi > 3.16\,\varphi_0$$

after intersection with curve C: as curve C

Curve B: Cross-polar component (dB relative to main beam gain)

$$-\left(40 + 40\log\left|\frac{\varphi}{\varphi_0} - 1\right|\right) \qquad \text{for } 0 \leqslant \varphi \leqslant 0.33\,\varphi_0$$

$$-33 \qquad \text{for } 0.33\,\varphi_0 < \varphi \leqslant 1.67\,\varphi_0$$

$$-\left(40 + 40\log\left|\frac{\varphi}{\varphi_0} - 1\right|\right) \qquad \text{for } \varphi > 1.67\,\varphi_0$$

after intersection with curve C: as curve C

Curve C: Minus the on-axis gain (Curve C in this figure illustrates the particular case of an antenna with an on-axis gain of 43 dBi).

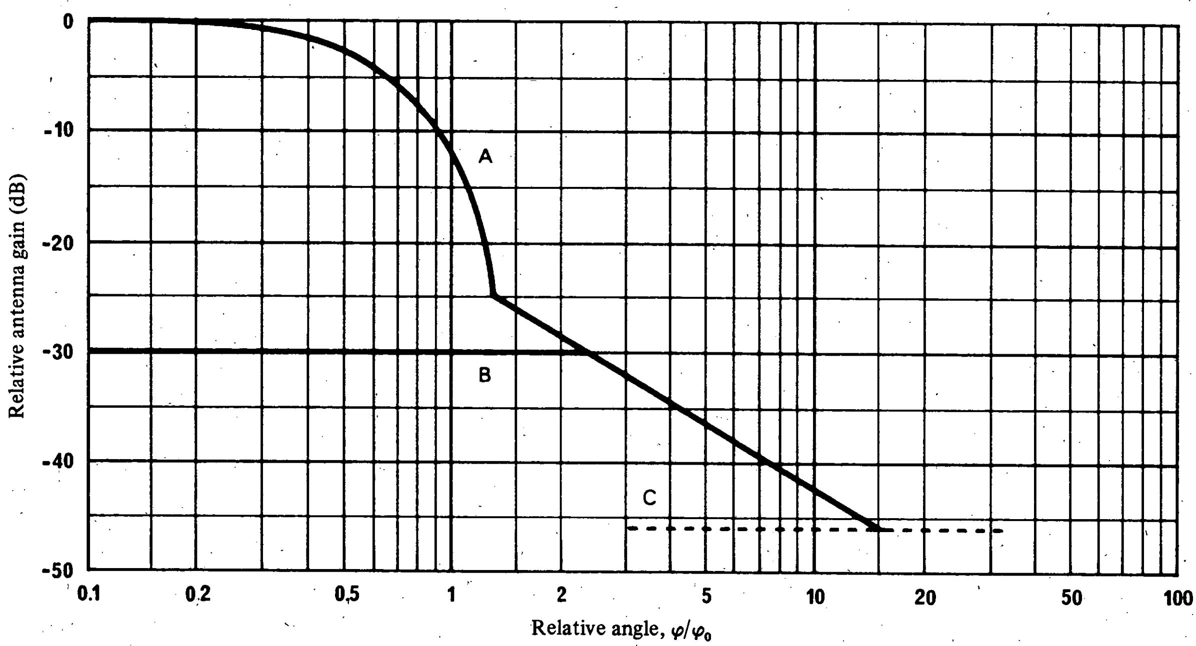

FIGURE 4 – *Reference patterns for co-polar and cross-polar components for satellite transmitting antennas in Region 2*

Curve A: Co-polar component (dB relative to main beam gain)

$-12\ (\varphi/\varphi_0)^2$ for $0 \leqslant (\varphi/\varphi_0) \leqslant 1.45$

$-[22 + 20 \log (\varphi/\varphi_0)]$ for $(\varphi/\varphi_0) > 1.45$

after intersection with curve C: curve C

Curve B: Cross-polar component (dB relative to main beam gain)

-30 for $0 \leqslant (\varphi/\varphi_0) \leqslant 2.51$

after intersection with co-polar pattern: co-polar pattern

Curve C: Minus the on-axis gain. (Curve C in this figure illustrates the particular case of an antenna with an on-axis gain of 46 dBi)

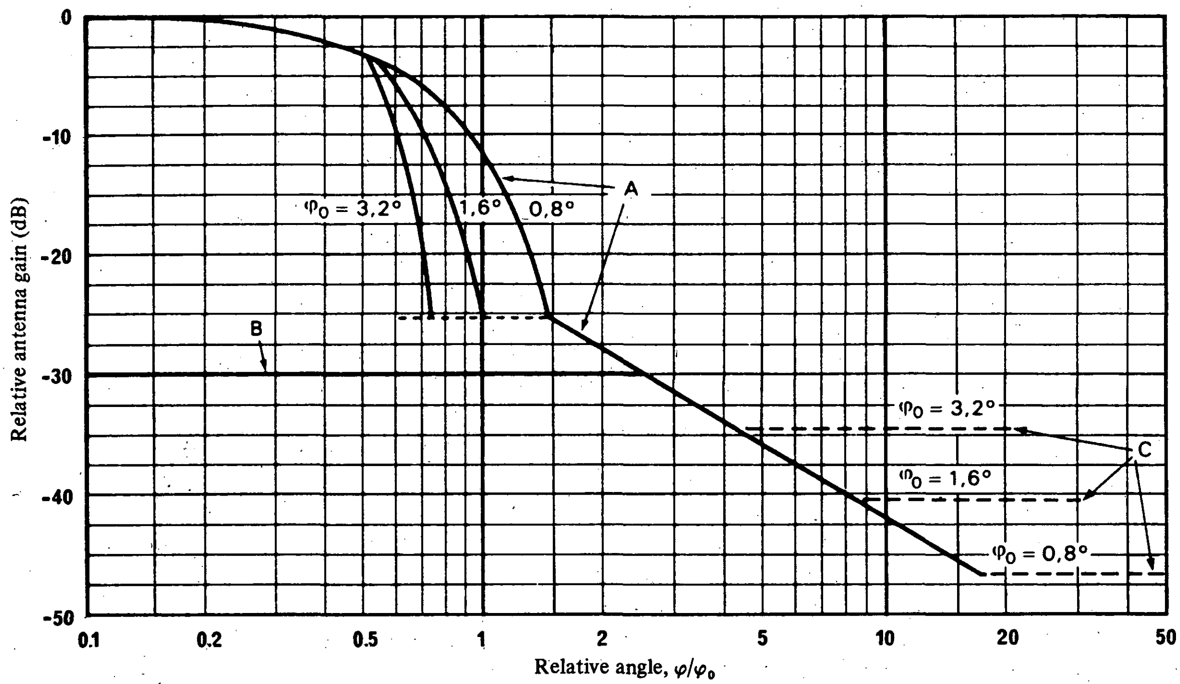

FIGURE 5 – *Reference patterns for co-polar and cross-polar components for satellite transmitting antennas with fast roll-off in the main beam for Region 2*

Curve A: Co-polar component (dB relative to main beam gain)

$-12\ (\varphi/\varphi_0)^2$	for $0 \leqslant (\varphi/\varphi_0) \leqslant 0.5$
$-18.75\ \varphi_0^2\ (\varphi/\varphi_0 - x)^2$	for $0.5 < (\varphi/\varphi_0) \leqslant \left(\dfrac{1.16}{\varphi_0} + x\right)$
-25.23	for $\left(\dfrac{1.16}{\varphi_0} + x\right) < (\varphi/\varphi_0) \leqslant 1.45$
$-[22 + 20 \log (\varphi/\varphi_0)]$	for $(\varphi/\varphi_0) > 1.45$

after intersection with curve C: curve C

Curve B: Cross-polar component (dB relative to main beam gain)

-30	for $0 \leqslant (\varphi/\varphi_0) < 2.51$

after intersection with co-polar pattern: co-polar pattern

Curve C: **Minus the on-axis gain (Curves A and C represent examples of three antennas having different values of φ_0 as labelled in Fig. 5. The on-axis gains of these antennas are approximately 34, 40 and 46 dBi, respectively)**

where:

φ : off-axis angle (degrees)

φ_0: dimension of the minimum ellipse fitted around the down-link service area in the direction of interest (degrees)

x : $0.5 \left(1 - \dfrac{0.8}{\varphi_0}\right)$

SECTION 10/11D: PLANNING

There are no Recommendations in this Section.

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SECTION 10/11E: SHARING

RECOMMENDATION 600-1

STANDARDIZED SET OF TEST CONDITIONS AND MEASUREMENT PROCEDURES FOR THE SUBJECTIVE AND OBJECTIVE DETERMINATION OF PROTECTION RATIOS FOR TELEVISION IN THE TERRESTRIAL BROADCASTING AND THE BROADCASTING-SATELLITE SERVICES

(Question 1/10 and 11, Study Programmes 1A/10 and 11, 1C/10 and 11, 1D/10 and 11)

(1982-1986)

The CCIR,

CONSIDERING

(a) that several experiments have been carried out for the determination of protection ratios for television;

(b) that some of these experiments have been carried out using different test conditions and measurement procedures, so that the results cannot be readily interpreted and compared;

(c) that the values of subjectively measured protection ratios depend on a large number of factors;

(d) that it is desirable to establish a standardized set of test conditions and measurement procedures in order that the results of subjective measurements of protection ratios for television made by different administrations may be properly interpreted and applied,

UNANIMOUSLY RECOMMENDS

that the following set of test conditions and measurement procedures described in Annex I should be used for the subjective and objective determination of protection ratios for television, whenever possible.

ANNEX I

1. Introduction

The protection ratio is the minimum value of the wanted-to-unwanted signal ratio, usually expressed in decibels, at the receiver input determined under specified conditions such that a specified reception quality of the wanted signal is achieved at the receiver output (Note 1). The protection ratio is useful in planning and operations where multiple transmissions require frequency and orbit sharing between similar or dissimilar transmissions.

Protection ratios for monochrome television systems and for colour television systems using vestigial sideband amplitude-modulation are found in Recommendation 655. For satellite broadcasting, a summary of results of protection ratio tests made by several administrations in cases where the wanted and unwanted signals are modulated by colour television signals or other transmissions such as multiple sound channels are found in Report 634 (see Note 2).

The assessment of protection ratios for television signals is made following the method established in Recommendation 500 and taking into consideration Report 405. Procedures can entail absolute or comparative methods of assessment depending on the specific investigations being carried out.

The test arrangements and measurement procedures presented next are recommended for use in tests for the determination of protection ratios for television [CCIR, 1978-82a and b].

Note 1 – This definition is in line with the definition of protection ratio found in Report 625 and in No. 164 of the Radio Regulations.

Note 2 – Protection ratio data for interference between an amplitude-modulation, vestigial-sideband or a frequency-modulation television signal and the types of signals used in the fixed and mobile services will be found in Report 449.

2. Measurement procedure and laboratory assessment of protection ratios

2.1 *Reference case conditions*

The values of subjectively measured protection ratios depend on a number of factors.

In order to allow that the results of subjective measurements of the protection ratio made by different administrations may be properly interpreted and applied, tests should be performed under a set of reference case conditions for the factors affecting these subjective measurements (see Table I).

TABLE I – *Factors affecting subjectively measured protection ratios and a set of reference case conditions for these factors*

Factor	Reference case condition	
	Terrestrial	Satellite
Picture impairment assessment scale	(See Rec. 500)	(See Rec. 500)
Number of levels	5	5
Definition of levels (perceptibility, annoyance, quality)	Impairment	Impairment
Fraction of time interference effects are visible	Continuous	Continuous
Impairment level for tests	Note 14	4.5
Viewers	(See Rec. 500)	(See Rec. 500)
Number	10-20 minimum	10-20 minimum
Expertise	Note 1	Note 1
Receivers	Note 2a	Note 2b
Number and types		
Performance parameters (selectivity, sensitivity, overload characteristics, etc.)		
Viewing conditions	(See Rec. 500)	(See Rec. 500)
Distance to screen		
Brightness of picture		
Brightness of background		
Wanted signal characteristics		
Colour or monochrome	Note 3	Note 3
Television standard (M, G, I, L, ...)	Variable	Variable
Colour system (NTSC, PAL, SECAM, ...)	Variable	Variable
Accompanying sound	Note 4a	Note 4b
Line synchronization	Note 5	Note 5
Picture type (still, moving) and content	Note 6	Note 6
Amount of detail in picture	Note 6	Note 6
Type of modulation (AM/VSB, FM, digital)	Variable, Note 7	Variable, Note 7
Modulation index	–	Note 8
Pre-emphasis characteristics for FM	–	Rec. 405
Energy dispersal characteristics	–	Nil
Fading	Nil	Nil
Unwanted signal characteristics	Note 9	Note 9
Carrier frequency offset	Note 14	Note 10
Frequency of operation	Note 11	Note 11
Video signal-to-noise ratios	Note 12	Note 12
Receiver noise		
Man-made noise		
Picture source noise		
Other interferences and sources of picture degradation	Note 13	Note 13
Other interfering signals		
Multipath		
Receiver distortion		

Note 1 – Both expert and non-expert viewers may be used. Tests with non-expert viewers are representative of the general population but tend to be quite lengthy. A great number of variables can be examined by using a small group of expert viewers. For the particular interference being examined, the relationship between expert and non-expert opinion should be investigated.

Note 2a – The receivers used in the test should represent equipment which is fairly sensitive to the type of impairment being investigated. Full account should be taken of the performance of domestic receivers, and measurements of the RF/IF response characteristics should be made to assist in the interpretation of the results. Account should also be taken of the type of receiver which may be used at re-broadcast relay stations.

Note 2b – The receivers used in the test should represent equipment which is fairly sensitive to the particular type of impairment being investigated. Account should be taken of domestic receivers, and the type of receivers which may be used at re-broadcast relay stations. It is important to indicate the type of discriminator used (staggered-circuit or phase-locked loop) as well as the bandwidth characteristics of the receiver (IF filter characteristics or equivalent characteristics in the case of a loop discriminator). Measurement of RF and IF filter characteristics should be made to assist in the interpretation of the results obtained when there are frequency offsets between the wanted and unwanted signals. As far as possible, filter characteristics should be adjusted to the standards applicable to the wanted signal. Baseband output frequencies should be limited to the minimum required for the television standard used for the wanted signal. Excessive filter bandwidths permit the observation of noise and interferences that would not be encountered with properly adjusted receivers.

Note 3 – Subjective tests should be based on colour pictures, unless there is reason to suppose that monochrome pictures would result in more stringent requirements.

Note 4a – If applicable standards exist for the accompanying sound channel(s), those standards should be used and the modulation characteristics noted. If no existing standards are applicable, full details of the characteristics of any sound signal(s) present should be given.

Note 4b – If applicable standards exist for the accompanying sound channel(s), those standards should be used and the main carrier deviation caused by the sound sub-carrier(s) should be noted. If no standards exist one should additionally indicate the sound sub-carrier frequency(ies) and the deviation of the sound sub-carrier(s).

Note 5 – The timing of the vertical and horizontal synchronization of the unwanted television signal should be such that when interference is visible, the interfering vertical and horizontal synchronizing bars are near the centre of the wanted picture.

The synchronizing signal of the wanted signal should be locked to the synchronizing signal of the unwanted signal, but with fields displaced so that sync bars from the unwanted signal are visible as interference on the wanted picture. Greatly different sync frequencies cause flicker in the picture and produce subjectively more noticeable interference.

Note 6 – The test pictures used should be reasonably critical still pictures, as they may occur fairly frequently in practice. The scenes should contain bright, saturated colours. Slides suggested for tests are described in § 2.2. Colour bar modulation is often used as the unwanted signal.

Note 7 – If applicable standards exist for the characteristics of either the wanted or unwanted signals, those standards should be used. If no standards exist, as for a frequency-modulation television signal for broadcasting, then the succeeding entries in Table I should be used. The sense of modulation should be such that a black-to-white transition corresponds to an increase in the instantaneous frequency.

Note 8 – A peak-to-peak frequency deviation sensitivity of 12 MHz/V should be used, if applicable. When other values are used, the peak-to-peak deviation should be indicated.

Note 9 – In most cases the unwanted signal has the same characteristics as the wanted signal. There is, however, also a need for the determination of protection ratios between dissimilar systems. In these cases the unwanted signal can have characteristics different from the wanted signal or can be another type of transmission such as multiple sound channels.

Note 10 – For co-channel protection ratio measurements there is no carrier frequency offset: carrier frequency offset is defined as the difference between the unmodulated carrier frequencies of the unwanted and wanted signals, ($f_{wanted} - f_{unwanted}$), if the same type of modulator is used in both channels. However, if the interference is sensitive to particular offset frequencies, these should be identified by the testing programme. For adjacent-channel protection ratios, a series of measurements should be made for frequencies of the unwanted signal varying approximately ± 30 MHz from the wanted signal.

Note 11 – Tests may be conducted at either radio – or intermediate – frequencies. Protection ratios between wanted and unwanted signals are affected by the types of signal, their frequency separations, and other factors which do not depend on the frequency range used.

Note 12 – As far as possible, the only noise which should be present on the picture when assessing protection ratios is that of thermal noise in the receiver. The protection ratios should be measured for pictures having a signal-to-unweighted-noise ratio of not less than 36 dB, in order that system performance should not be limited by possible masking of interference by noise.

Note 13 – No account should be taken of other sources of interference, etc. (except thermal noise, as mentioned above), when assessing the protection ratio.

Note 14 – For 625-line systems, the reference impairment levels are those which correspond to wanted-to-unwanted signal-to-noise ratios of 30 dB and 40 dB with a frequency offset between vision carriers of two-thirds of the line frequency but adjusted within a plus and minus 25 Hz range to produce maximum impairment, the precise frequency difference being 10.416 kHz. These conditions are approximate to mean impairment grades 3 and 4 and are respectively applicable to short-term (tropospheric) and continuous interference.

2.2 *Test pictures*

The test pictures used (see Recommendation 500) should be chosen from a set available to all administrations, so as to allow comparisons of results. Not only is the subjective evaluation of the interference dependent upon the test picture, but also the amount of baseband interference is dependent upon the modulated spectral densities of both signals, and the spectral densities depend on the video content. Test slides generally available are those of the Society of Motion Picture and Television Engineers (SMPTE) subjective colour reference slide series and the Philips test slides for colour television. The test slides from the SMPTE series are selected stills from the SMPTE reference test film. Two slides from each series are recommended for the wanted signal during tests on the impairments caused by interference. These are:

I. SMPTE

Colour television test slides
Slides Cat. TV CS-3
No. 1 Beach scene
No. 14 Girl in green dress

II. PHILIPS

Test slides for colour television

No. 8 Basket of fruit
No. 14 Make-up scene

The means used to provide the television picture signal (which might include the use of a frame-store synchronizer or similar technique) should ensure that the picture displayed in the absence of interference is of high quality; in particular any impairment should be insignificant compared with the grade of impairment used for determining the protection ratio.

2.3 *Other conditions*

In performing television protection ratio measurements, highest priority should be given to tests at the "reference case" conditions given in § 2.1. If other test conditions and parameters must be used, they should be defined and correction factors given so that results applicable to the reference test conditions may be deduced.

When the use of a video tape recorder will not add to the interference present or will not diminish or mask those interferences, and where the experiment design allows repetitive signals and sequences, it is recommended that presentations to viewers be made from video tapes. The use of video tape permits presentation to large numbers of viewers with comparative ease, guarantees duplication of test conditions and accompanying commentary, and permits post-test verification of the conditions shown.

For protection ratio measurements, interference should be evaluated on the five grade impairment scale given in Recommendation 500 using the viewing conditions and presentation in § 2.4 and 2.5 of that Recommendation. Wherever possible, information should be provided on the variation of protection ratio with the subjective grade. For the purpose of comparing results, it is desirable to provide the subjective grades together with the corresponding standard deviation for different values of C/I.

REFERENCES

CCIR Documents

[1978-82]: **a.** 10-11S/54 + Corr. 1 (Brazil); **b.** 11/119 (Brazil).

92-61-04271-6