THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE

(C.C.I.T.T.)

SELECTED C.C.I.T.T. RECOMMENDATIONS

RELATING TO INTERNATIONAL SOUND AND TELEVISION PROGRAMME TRANSMISSIONS

Published by
THE INTERNATIONAL TELECOMMUNICATION UNION
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PREFACE

The publication of this compendium was approved by the Vth Plenary Assembly of the C.C.I.T.T. (Geneva, 4-15 December 1972) on the proposal of Study Group II. This new publication meets the wish expressed by many Administrations to have available in one book all of the C.C.I.T.T. Recommendations (normally to be found in several volumes of the *Green Book*) dealing with the different aspects (operation, transmission, maintenance) of international sound and television programme transmissions.

This compendium is intended mainly for the operating and technical staff of the programme booking centres, international sound programme centres, international television programme centres, and maintenance centres of Administrations and recognized private operating Agencies who are responsible for establishing and supervising transmissions of this kind.

International sound and television programme transmissions need to be established swiftly and reliably, sometimes at very short notice, and this demands perfect co-ordination of the operations involved. The sole aim of the compendium is to facilitate such co-ordination by presenting the relevant international provisions in consolidated form.

Since, in spite of their close ties, radio and television are two separate fields, the compendium has been split into two main parts, namely:

— Part I — dealing with international sound-programme transmissions;
— Part II — dealing with international television transmissions.

Each part is further split into three chapters each dealing with one of the three traditional major functions:

— operation;
— maintenance;
— transmission.

PART I

International sound-programme transmissions

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SUMMARY

Chapter 1 — OPERATION

(Recommendation in Volume II-A of the *Green Book*)

Chapter 2 — MAINTENANCE

(Recommendations in Volume IV.1 of the *Green Book*)

Chapter 3 — TRANSMISSION

(Recommendations in Volume III of the *Green Book*)

CHAPTER 1

OPERATION

INTERNATIONAL SOUND AND TELEVISION PROGRAMME TRANSMISSIONS

Recommendation E.330

SOUND AND TELEVISION PROGRAMME TRANSMISSIONS

1. *General*

In most cases, circuits used for sound and television programme transmissions are owned by Administrations although in some countries national broadcasting organizations own all or part of the circuits within national boundaries.

The provision of circuits for transmissions between two or more countries requires the closest cooperation between:

— the broadcasting organizations [1] concerned in a sound or television programme transmission, either as users or owners of sound programme and television circuits or both,

— and the Administrations concerned.

It is therefore recommended that the following principles for ordering and charging should be observed for international sound and television programme transmissions.

This Recommendation is intended to cover the use of facilities for sound and television programme transmissions only and not for other types of transmissions.

This Recommendation does not include provisions for the leasing for periods of one day or more of sound and television programme circuits, which are subject to the provisions of Recommendation D.4.

Provisions governing the technical aspects and maintenance of sound and television programmes and associated circuits are contained in the J, M and N Series Recommendations.

2. *Definitions*

The terms used in connection with sound and television programme transmissions, as defined below, apply to all such transmissions.

2.1 *Programme Booking Centre (P.B.C.)* (formely known as Controlling Service, in French "Service centralisateur", in Spanish "Servicio Centralizador")

The office of an Administration (or broadcasting organization where circuits are provided for international service by such an organization) which receives orders for international circuits for sound and/or television programmes from broadcasting organizations in its own country or from a broadcasting organization in another country or from the P.B.C. of another Administration and is charged with the task of making appropriate arrangements for providing the ordered circuits.

2.2 *International Sound Programme Centre (I.S.P.C.)* (in French "Centre radiophonique international" (C.R.I.), in Spanish "Centro Radiofónico Internacional" (C.R.I.))

A centre at which at least one international sound programme (audio) circuit terminates and in which international sound programme connections can be made by the interconnection of international and/or national sound programme circuits.

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[1] Any reference to broadcasting organizations in this Recommendation applies equally to other users.

The I.S.P.C. is responsible for setting up and maintaining international sound programme links and for the supervision of the transmissions made on them.

2.3 *International Television Programme Centre (I.T.P.C.)* (in French "Centre télévisuel international" (C.T.I.), in Spanish "Centro Internacional de Television" (C.I.T.))

A centre at which at least one international television circuit terminates and in which international television connections can be made by the interconnection of international and/or national television circuits.

The I.T.P.C. is responsible for setting up and maintaining international television connections and for the supervision of the transmissions made on them.

The centre at the end of a satellite television circuit is sometimes referred to as the Satellite International Television Programme Centre (S.I.T.P.C.).

2.4 *Broadcasting organization*

A broadcasting organization is an organization which is concerned with either or both sound and television broadcasting.

Most of the customers ordering facilities for sound and television programme transmissions are broadcasting organizations, and for convenience, the term broadcasting organization is used in this Recommendation to denote activity of any user or customer, and where so used, is equally applicable to any other customer requiring sound or television programme transmissions.

2.5 *Categories of transmissions*

2.5.1 *Regular transmissions* are those which take place at regular intervals, at fixed times between the same points. Some regular transmissions may be subject to special contractual arrangements.

2.5.2 *Occasional transmissions* are all those which do not fall within the definition of regular transmissions.

2.5.3 *Simple transmissions* are one-way transmissions from a point of origin in one country to a receiving point in another.

2.5.4 *Multiple transmissions* are those transmissions which originate in one or more countries, from one or more points of origin, and are transmitted simultaneously to two or more countries.

2.6 *Categories of circuit*

2.6.1 *Sound programme circuit* (or audio circuit) is a unidirectional circuit, for the transmission of a sound programme or a sound component of a television programme [1]. The various types of audio circuits are described in 3.

2.6.2 *Television circuit* is a unidirectional circuit for the transmission of the video component of a television programme.

2.6.3 *Control circuit* is a telephone type circuit which may be used by a broadcasting organization for the supervision and/or coordination of a sound or television programme transmission [2].

2.7 *Constitution of sound and television programme connections*

2.7.1 An international sound or television programme connection is a unidirectional path between broadcasting organizations and consists of:

a) the point to be regarded as that of the origin of the transmission (Point A);

b) the outgoing national circuit which connects Point A to the first I.S.P.C. or I.T.P.C., (Point B);

c) an international link comprised of any combination of international or national terrestrial, submarine cable, HF radio or satellite circuits or circuit sections; a satellite circuit consists of a satellite section between and including the earth stations and extended by terrestrial means to the I.S.P.C.s or I.T.P.C.s at the ends of the satellite circuit;

[1] More than one such audio circuit may be required for association with a single television circuit.

[2] More than one such control circuit may be required for association with a single television circuit.

d) the incoming national circuit which connects the last I.S.P.C. or I.T.P.C. (Point C) to Point D;

e) the point of destination of the transmission (Point D).

The various parts of international connections are illustrated in Figures 1/E.330 and 2/E.330.

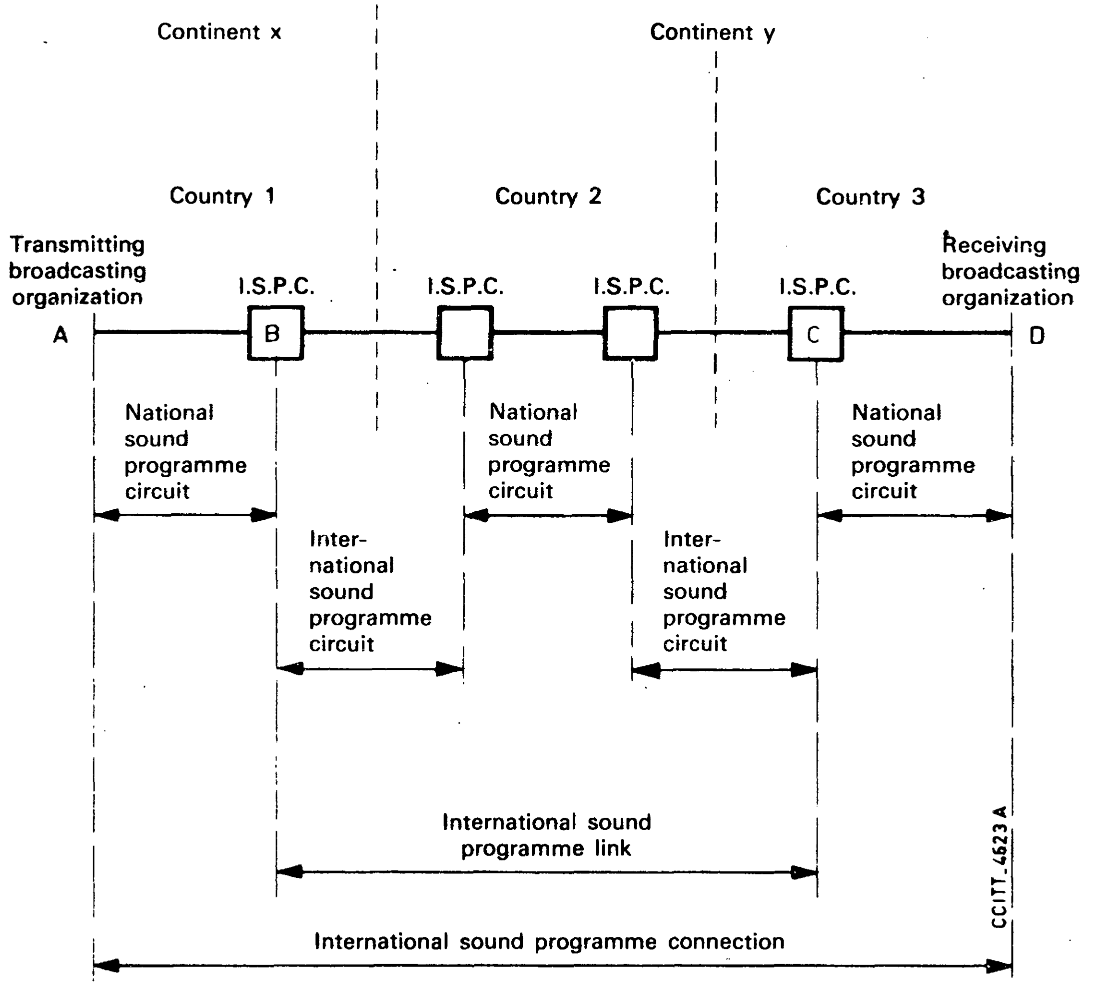


FIGURE 1/E.330. — **Example of an international sound programme connection.**

2.7.2 The complete chain between A and D, including the international link B-C and the local ends (A-B and C-D) is the "International sound or television programme connection".

2.7.3 Points A and D are, as a general rule, under the control of the originating and receiving broadcasting organizations.

Points B and C are, in principle, under the control of the Administrations of the corresponding countries.

The circuit B-C is generally under the control of the Administrations but certain of its component parts (which may be national or international circuits) and some I.S.P.C.s and I.T.P.C.s may be owned or operated by broadcasting organizations.

The local ends A-B and C-D may be under the control of either an Administration or a broadcasting organization, or both jointly, according to the actual arrangements in the countries concerned.

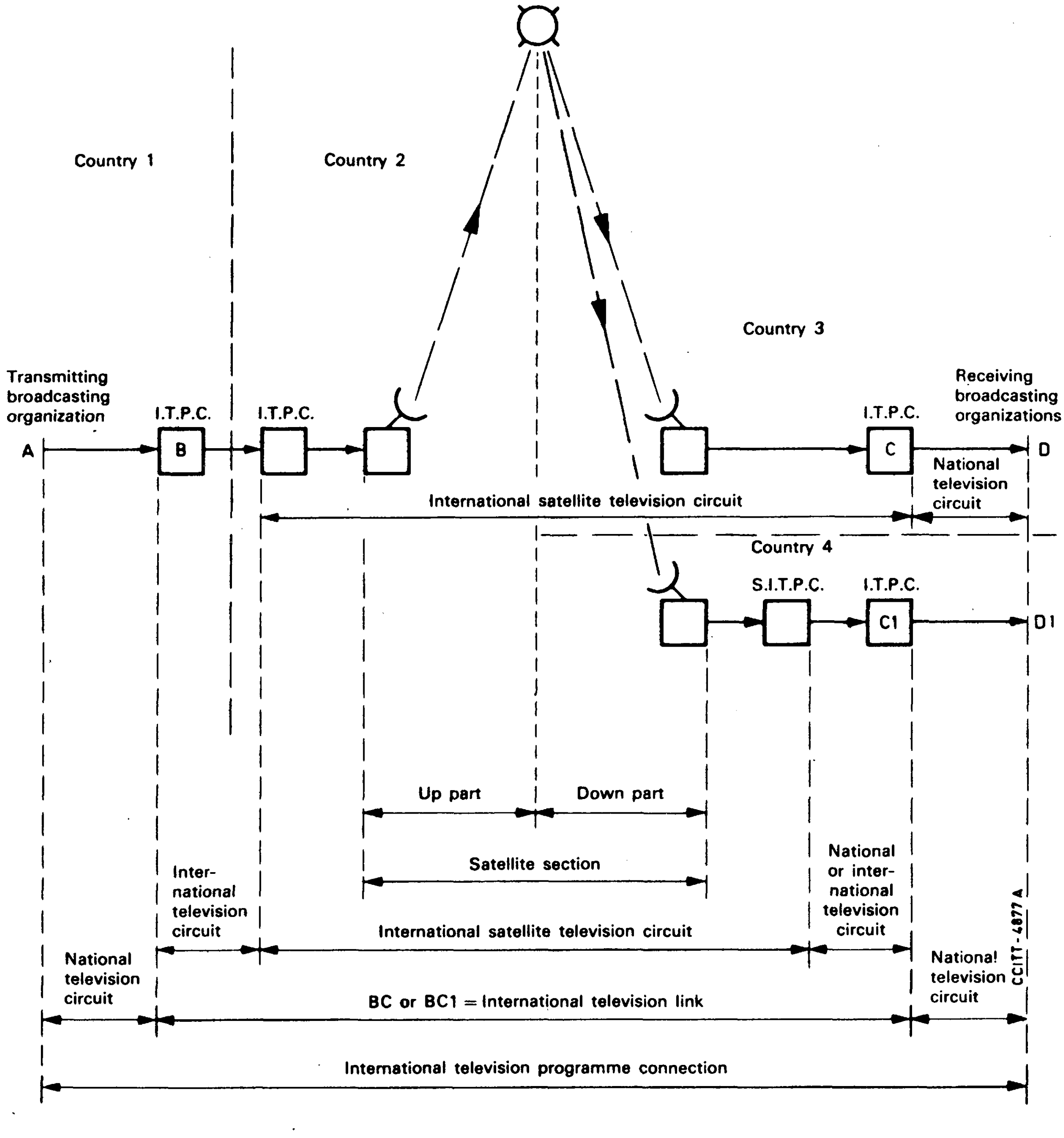


FIGURE 2/E.330. — **Example of an international television programme connection involving a satellite circuit.**

3. *Audio circuits*

3.1 The types of audio circuits that may be provided for audio transmission for sound and television programmes are referred to as follows for ordering and charging purposes:

Types of audio circuit	*Approximate bandwidth*
Narrow-band	3 kHz
Medium-band	5 kHz
Wide-band	10 kHz
Very wide-band	15 kHz
Stereophonic pair	2 at 15 kHz each

Detailed technical parameters of some types are given in the J and N Series Recommendations.
A stereophonic pair consists normally of two very wide-band circuits, which must be carefully matched. Each circuit of a stereophonic pair may also be used separately for monophonic transmissions.

3.2 Narrow-band audio circuits may be ordinary telephone circuits. They are provided in varying forms, but are routed through the I.S.P.C. for setting-up and maintenance. When provided on a four-wire basis, the return path may be used as a unidirectional control circuit.

3.3 The five types of circuit in 3.1 above provide for the continued use of existing facilities (e.g. circuits with a top nominal transmitted frequency of 6.4 kHz, both "old" and "new" types, would be medium-band circuits as well as those with a top nominal frequency of 5 kHz) as well as future requirements, and apply equally:

— for both sound and television programme transmissions, and

— for terrestrial, submarine cable, HF radio and satellite circuits.

3.4 Administrations may decide to provide only those audio circuits of the five types for which sufficient customer demand is indicated.

3.5 When an Administration cannot provide the type of circuit that is ordered, if time permits, it will inform the broadcasting organization of the type of circuit that can be made available. When time does not permit consultation with the broadcasting organization, the Administration should provide a circuit of the nearest suitable type available.

4. *Ordering of circuits and conditions of acceptance*

4.1 *Orders*

4.1.1 Orders for the use of circuits for sound and television programme transmissions should normally be addressed by a broadcasting organization to the Administration of its country. The broadcasting organizations concerned should coordinate their arrangements before placing orders for circuits. Orders for all the circuits to be established should usually be placed by the broadcasting organization which is to receive the transmission.

4.1.2 With prior agreement of the broadcasting organizations concerned, and particularly for some multiple transmissions, orders may be placed with the Administration of the country in which the transmission will originate or of any intermediate transit country.

4.1.3 When agreement has been reached on the orders to be placed, the originating broadcasting organization should provide its Administration with a list, for information purposes, of all the circuits to be established. Provision of this list does not constitute an order for circuits. In addition, if the broadcasting organizations concerned have appointed a coordinating centre for a transmission, it should send a list of all circuits to be established to the Administrations concerned (see Recommendation N.52).

4.1.4 Each order, which should be clearly identified as such, carries with it an undertaking to pay all the charges relating to the use of the facilities ordered, including any cancellation fee or special expenses which may be incurred in connection with the order.
If time permits after an order has been placed, an estimate of any special expenses which are likely to be a major part of the total should be given to the broadcasting organization.

4.1.5 Orders for the use of circuits will be met subject to availability of facilities. The Programme Booking Centre receiving orders should confirm acceptance and availability of circuits as soon as possible unless special arrangements have been made nationally between the Administration and the broadcasting organization which has placed the order. When time permits, orders and confirmations should normally be in written form (e.g. telex).

4.1.6 It is in the interest of both broadcasting organizations and Administrations that orders should be placed as soon as possible, preferably at least 24 hours before the transmission is scheduled to take place. Administrations should always do their best to provide circuits at shorter notice. Broadcasting organizations should always do their best to place orders as early as possible, particularly in those cases where special construction of facilities will be required.

4.2 *Handling of orders received by Administrations*

4.2.1 The Administration receiving an order is responsible for passing the order to all other Administrations concerned and for obtaining from them confirmation of the availability of the circuits and facilities required.

4.2.2 Facilities for sound and television programme transmissions should be allocated in the sequence in which orders are received.

4.2.3 For television programme transmissions via satellite:

a) the Administration receiving the order is responsible for arranging the circuits between the broadcasting organization and the appropriate I.T.P.C. at the end of the satellite circuit (S.I.T.P.C.);

b) the Administration operating this I.T.P.C. is responsible for confirming the availability of the satellite circuit and for ordering its portion of that circuit; and

c) the Administration operating the I.T.P.C. at the other end of the satellite circuit is responsible for ordering its portion of the satellite circuit and for arranging the circuits between its I.T.P.C. and the other broadcasting organization.

This procedure normally applies also to audio and control circuits provided by means of satellite channels specially assigned for use in association with television transmissions but not necessarily to other audio circuits provided via the satellite or to audio circuits provided by any other means, e.g. submarine cable.

4.3 *Cancellations*

4.3.1 A cancellation fee may be charged by Administrations if, for reasons not within their control, the order is cancelled:

a) less than 24 hours, but more than 2 hours before, the time scheduled for the beginning of the transmission (see 4.3.2 below); or

b) less than 2 hours before the time scheduled for the beginning of the transmission (see 4.3.3 below).

The time to be considered in determining these limits is the time at which the broadcasting organization submits its cancellation request to the P.B.C. which received the original order.

4.3.2 The fee with regard to a above should be such as to cover the administrative expenses already incurred by Administrations following receipt of the order. This should provide some incentive to broadcasting organizations to cancel orders in sufficient time for the circuits concerned to be made available to another customer. This fee should not be charged unless the order has been accepted and confirmed by the Administration concerned.

4.3.3 The fee with regard to b above should be such as to cover, in addition to the expenses referred to in 4.3.2, any additional preparation for the transmission, and to compensate in part for loss of revenue which might have been obtained by making the circuit available to another customer. This fee may be charged whether or not the order has been confirmed by the Administration concerned.

4.3.4 In all cases, Administrations may require reimbursement of any documented special expenses incurred, e.g. in the provision of specially engineered circuits, even when the transmission is cancelled with more than 24 hours notice.

4.4 *Alterations in orders*

An alteration to an order for which the Administrations are not responsible should be considered as a new order which cancels the original one. The original order is therefore subject to the cancellation fee referred to in 4.3 above when the alteration request is made within the specified time limit, except that no fee is payable in respect of:

a) a change of less than a total of 2 hours in the time scheduled for the beginning of the transmission, regardless of the number of individual alterations;

b) a change in the scheduled time such that the new transmission period overlaps the original period;

c) a change in the overall duration of the programme;

d) a change in the routing of circuits beyond the extremities of the international link provided that no alteration whatsoever is requested in the international link.

5. *Charging principles*

The total charge for an international programme transmission is the sum of the charges for the various circuit sections (see 2.7 and Figures 1/E.330 and 2/E.330).

The international charges should normally have two basic elements:

1) a fixed charge designed to cover preparation and operation, and

2) a charge based on duration of the connection.

The fixed charge may include a minimum duration of use.

In view of the great disparity in the cost of the various components of, on the one hand, terrestrial circuits of the type used mainly within continents and, on the other hand, satellite and long-distance submarine cable circuits used mainly for intercontinental relations, it is not possible to recommend one single method for developing the charges for each individual section.

Administrations which of necessity operate using more than one method of charging should define the interconnecting points for the application of the different methods. This should normally be an I.S.P.C. or an I.T.P.C.

Whenever possible the same method of charging should be used within the same region.

5.1 *Charging for sound and television programme transmissions except as provided in 5.2 for transmissions via satellite, HF radio or intercontinental submarine cable circuits*

5.1.1 The charge normally should be made up of the following elements:

a) a fixed charge for the preparation and operation per transmission and per country having an interconnecting point (whatever the number of interconnecting points within the terminal and transit countries);

b) a charge per minute of transmission per terminal country, which may be expressed differently for:

— a sending terminal

— a receiving terminal

— a branching terminal in a multiple transmission;

c) a charge per minute of transmission and per interconnecting point in a transit country;

d) a charge per minute of transmission based on the length of line;

e) any special expenses incurred in the setting up of special circuits to connect with existing facilities and any special changes for use of national facilities not covered by the charges of a and d above.

Details of existing practices in some areas of the world are included as examples in Annex 1 [1].

5.1.2 The use of an audio circuit established on a sub-carrier of a channel used for television transmission is charged as for an audio circuit provided for an independent sound programme transmission.

5.1.3 In principle, use of different types of audio circuits to make up an international sound programme link should be avoided. However, if it is necessary to use different types of circuits for any section of a link, the charge applicable to all sections would be that for the lowest quality type used. The sharing of charges between Administrations should be on the basis of the lowest charges applied.

If a broadcasting organization orders a higher quality audio circuit for a particular section of the link, the charges for that higher quality type would apply to that section.

5.1.4 If a narrow-band circuit is provided for use as a sound-programme circuit, items b, c and d in 5.1.1 may be combined in a charge related to the charge for an appropriate telephone call in the relation concerned.

Note. — This does not obviate the need to pay the charges at a and e as appropriate.

When a-circuit provided on a four-wire basis is used for programme transmission in one direction and for supervision and/or coordination in the other direction (see 3.2) an additional charge may be made.

[1] Former C.C.I.T.T. charges for continental-type transmissions are shown in Annex 2.

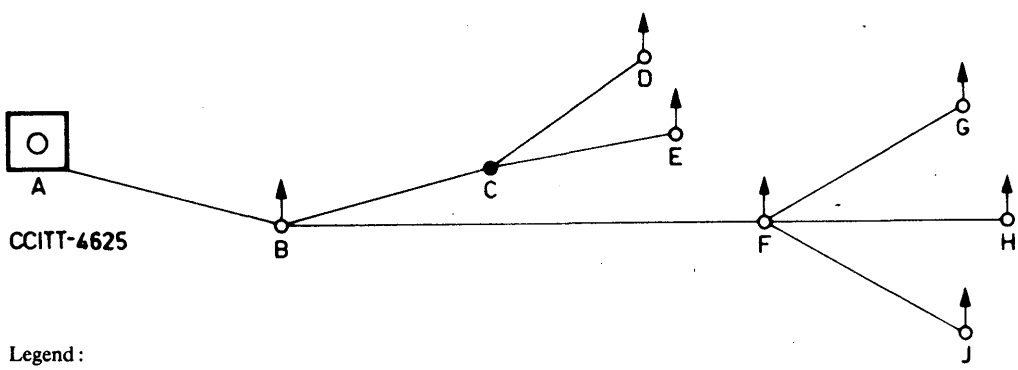
5.1.5 A multiple transmission, where the programme is routed over an interconnected network of international circuits and is received simultaneously in several countries, is considered, from the charging point of view, as separate transmissions:

— from the point of origin to the first receiving terminal;

— from the first receiving terminal to the next receiving terminal, and so on;

— from a branching point across a circuit between two terminals to the next receiving point.

5.1.6 Broadcasting organizations should arrange among themselves which will pay charges for common sections of circuit in mutliple transmissions. The diagram at Figure 3/E.330 illustrates how such arrangements and the principles in 5.1.5 should be applied.



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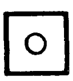
International terminal of country of originating broadcasting organization


International terminal where the transmission is used by a broadcasting organization


Interconnection point where the transmission is not used by a broadcasting organization

FIGURE 3/E.330. — **Example of a multiple transmission.**

In Figure 3/E.330, it is assumed that the broadcasting organization in B, which broadcasts the transmission coming from A, pays the charge for the circuit A-B, that the broadcasting organization in F pays the charge for the circuit B-F, while the broadcasting organizations in G, H and J pay for the circuits F-G, F-H and F-J respectively.

As C is not broadcasting the transmission, the broadcasting organizations in D and E should arrange in advance which of them will pay the charge for the circuit B-C. If, for example, the broadcasting organization in D agrees to pay the charge for the circuit B-C, the charges to be collected in D and in E respectively should be based on a transmission from B to D and a separate transmission from C to E.

If, during a transmission, an additional broadcasting organization is connected to any part of the international link, that broadcasting organization will be responsible for all additional charges concerned in that transmission.

5.1.7 When several different routes exist in any given relation the total charge for each of the routes is the sum of the quotas due to each country for the actual route followed. The choice of route is normally left to the discretion of Administrations. However, a broad-

casting organization may request a specific route, which should be provided by the Administration concerned if possible.
In the case of direct transit of a country where the transmission is not broadcast, and when there is more than one route through that country, its Administration should normally fix a uniform transit charge for transit of its country in a given relation.

5.1.8 There is a minimum chargeable duration for sound and television programme transmissions [1].

5.1.9 The same charge should apply in principle to both colour and monochrome television transmissions and normally at all times of the day and night.

5.1.10 Where a normal telephone circuit is provided for use as a control circuit, the appropriate telephone charge between the terminal countries should be applied. Where additional facilities are provided in connection with such a circuit, Administrations may make appropriate charges for such facilities.

5.2 *Charging for sound and television programme transmissions via circuits furnished by means of satellite, HF radio or intercontinental submarine cable*

5.2.1 A minimum charge should be made covering an initial period [2] hereinafter referred to as the "initial period charge", plus a per-minute charge for each minute or part minute thereafter.

5.2.2 The charge for a satellite television circuit is made up of an "up part" and a "down part" charge, each including its terrestrial extension to the I.T.P.C.
Each Administration should establish a charge for the part which it controls.

5.2.3 For sound-programme transmissions the charge between international centres shall be established by agreement between the Administrations concerned. This charge may be related to, but not necessarily the same as, the telephone rate and should be shared between Administrations in a similar manner.

5.2.4 For consecutive television transmissions ordered by different broadcasting organizations using the same satellite circuit, only one initial period charge may be made, as though they amounted to a single transmission. The duration of each of the consecutive transmissions should then be considered, for purposes of calculating the charges, at least as long as an initial chargeable period.

5.2.5 For a multiple transmission via satellite involving a satellite circuit with more than one receiving earth station, the satellite circuit is considered, for charging purposes, to have several separate parts:

— one between the point of origin and the satellite (up part);

— others between the satellite and each receiving earth station country (down parts).

The charge for the up part normally should be divided amongst the receiving earth station countries based on the time of usage of each down part. When this charge varies according to the point of destination, the highest charge should be applied.

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[1] In 1972, current practice was to apply three minutes.

[2] In 1972, current practice was ten minutes.

The Administration providing the up part may levy a surcharge for a multiple transmission to cover the additional costs of preparation. This surcharge should be shared by the receiving countries in proportion to their time of usage.
The same procedure may apply to any charges for circuits earlier in the connection.

5.2.6 For alternate transmissions in which the direction of transmission alternates between two points in a given period, the individual durations may be summed to determine the chargeable duration in each direction.

5.3 *Determination of the chargeable duration*

5.3.1 The I.S.P.C.s and I.T.P.C.s concerned in a transmission should come to an agreement between themselves and broadcasting organizations at the end of each transmission as to the chargeable duration:

a) the time at which the ordered connection was placed at the disposal of the broadcasting organization (beginning of the chargeable duration)—this is also the beginning of the preparatory period (see Recommendations N.4 and N.54);

b) the time at which the ordered connection was released by the broadcasting organization (end of chargeable duration)—sometimes referred to as the "goodnight time";

c) when necessary, the time and duration of any interruption which may have occurred.

The time at the beginning and end of the chargeable duration, as well as the time of any occurrence and duration of any interruptions are entered on a report. This report should be sent, preferably on the same day, to the office responsible for coordinating all the details necessary for the establishment of international accounts. In addition, details relative to interruptions are noted on the report sent periodically to the technical services concerned.

5.3.2 In case of disagreement, the opinion of the Administration in the receiving country on the duration of transmissions and interruptions shall prevail, except with regard to transmission orders which are placed and paid for at the transmitting end when the opinion of the Administration at that end shall prevail as regards the start and end times (though not as regards the duration of interruptions).

5.3.3 The start time of a transmission is the time scheduled when the order is placed, unless the circuit is handed over to the customer earlier at his request. It may be later than the scheduled time only if the Administrations have failed to provide the circuit in good working order on time.

5.3.4 There should be no obligation upon Administrations to monitor transmissions continuously. Consequently broadcasting organizations should be requested always to report at once if they are not satisfied with the transmission or if there is any interruption; Administrations, however, are not responsible for notifying broadcasting organizations of interruptions.

5.4 *Interruptions—allowances*

5.4.1 If during the course of a sound or television programme transmission, an interruption, even of short duration, occurs:

— whether on the connection,

— or in a section of that connection,

— or on one or more of the audio circuits associated with a television programme transmission,

— or in the video component only of a television programme transmission,

it is necessary to consider whether the broadcasting organizations affected by the interruption should be given a credit allowance.

5.4.2 The general test of whether an allowance is in order should be: Was the transmission used?

This implies that broadcasting organizations must decide on the spot whether to use or refuse an ordered connection.

In general, if a broadcasting organization continues to broadcast or record the programme transmission, the charges in respect of any circuits it uses remain payable in full. If, however, as a result of a fault or interruption on the circuit, no signals or faulty signals are received by one or more participating broadcasting organizations, an allowance in respect of the circuits serving each of these broadcasting organizations may be given. Each circuit used by any broadcasting organization which continues to broadcast or record the transmission remains payable in full.

Similarly, if in such circumstances broadcasting or recording of either the video or audio components of the programme (but not both) is discontinued by any broadcasting organization, an allowance in respect of the television or audio circuit concerned (but not both) may be given (see also 5.4.6 below).

5.4.3 Any interruption should be reported by the broadcasting organization; however, in cases of facility failures known to the Administration, such reports may not be required. While broadcasting organizations are normally required specifically to request allowances for interruptions, such requirement may be waived at the discretion of and according to the national practices of Administrations.

5.4.4 It will be for the Administration of the country of the receiving broadcasting organization to assess the validity of any claim for allowances, and to assess the allowance to be made, where necessary, in consultation with the other Administrations concerned. In the event of disagreement, the opinion of the Administration of the country of the receiving broadcasting organization shall prevail over that of the other Administrations concerned.

5.4.5 Credit for interruptions should be allowed on any transmission, regardless of the interval between the receipt of the order and start of the transmission.

5.4.6 It is accepted that interruption of an audio circuit associated with a television programme transmission may render the whole transmission valueless to the customer. However, the charges for the video circuit remain payable if the video transmission is broadcast or recorded by the broadcasting organization in accordance with 5.4.2 above.

5.4.7 All Administrations concerned in a transmission should make allowances for interruptions, regardless of where they took place.

5.4.8 No allowance will be given when the interruption is due to the negligence of the broadcasting organization or the failure of facilities provided by the broadcasting organization.

5.4.9 When a circuit failure makes it impossible to provide a transmission on the planned route, or causes an interruption in a transmission, an alternative routing should be established whenever possible provided that the broadcasting organization undertakes to pay additional charges that may apply. However, for those sound-programme circuits which can be readily rerouted, the broadcasting organization should pay the same total charge that would have applied if no failure had occurred.

5.5 *Measurement of distances for terrestrial circuits*

5.5.1 When part or all of the charge for a transmission is based on the length of circuit, the distance is normally taken as:

— in the case of the terminal country, the crowflight distance between the I.S.P.C. or I.T.P.C. and the point where the circuit crosses the frontier;

— in the case of the transit country, the crowflight distance between the points of crossing the frontier by the circuit;

— in both cases, in order to take better account of the cost actually incurred with a radio-relay link, the point midway between the two stations on either side of the frontier may be used instead of the actual point of crossing of the section of the link straddling the frontier.

5.5.2 However, the relatively high cost of television circuits and the wide disparity in many relations between crowflight and actual distances could make it desirable to base distance measurement for television circuits on actual distance.
Similarly, it might be appropriate to round up the actual distance in small rather than large steps (in some regions, actual distances are rounded up to the next 10 km).
It is recommended that regions should decide whether to use actual distance within their region or whether to retain the system of measurement described in 5.5.1 above for terrestrial television circuits.

6. *Accounting*

6.1 *Collection of charges*

In principle, the Administration with which the order was placed is responsible for collecting the charge for a transmission from the broadcasting organization which placed the order.

6.2 *Remuneration of Administrations*

The Administration with which the order for a transmission is placed is responsible for ensuring that the remuneration to other Administrations is entered into the international accounts in accordance with the provisions of Recommendation E.270. Unless otherwise agreed, the consolidated monthly accounts should be accompanied by supporting documents which will allow each transmission to be separately identified.

7. *Directory for handling orders for international sound and television programme transmissions*

To ensure speedy and reliable arrangements for international sound and television programme transmissions, it is essential that detailed information regarding the P.B.C.s all over the world which handle orders for such transmissions should be readily available to those concerned. This also applies to appropriate technical services and to the broadcasting organizations themselves.

In order that this information may be compiled in a directory, each Administration should draw up an information sheet for every Programme Booking Centre (P.B.C.), International Sound Programme Centre (I.S.P.C.) and International Television Programme Centre (I.T.P.C.) under its control. It is recommended that broadcasting organizations which handle orders for international transmissions should also draw up information sheets.

Up-to-date information sheets should be sent to the General Secretariat of the I.T.U. for the purpose of compiling, distributing and amending as necessary a common directory.

The information sheets should be in the form shown at Annexes 3 and 4 and should include, where applicable, the following basic particulars:

— Name of country,

— Name of office for which information is given (P.B.C., I.S.P.C., broadcasting organization, etc.),

— Name of Administration or broadcasting organization,

— Postal address,

— Telephone number(s),

— Telex number and answer-back,

— Telegraphic address,
— Office hours (GMT),
— Languages spoken,
— Senior staff and deputies,
— Contact outside office hours and on holidays,
— Office handling orders for leased circuits (if not P.B.C.),
— Earth station,
— Local time reference GMT,
— Name(s) of customer(s) for which orders normally handled.

ANNEX 1
(to Recommendation E.330)

Examples of sound and television programme charges

The following rates, which have been agreed by some European countries for use in their mutual relations in accordance with 5.1, are included as an example and for information.

Sound and television transmissions

Element	Audio circuits (in gold francs)					Television circuits (in gold francs)
	Narrow-band	Medium-band	Wide-band	Very wide-band	Stereophonic pair	
a) Fixed charge for preparation and operation per transmission and per country having an interconnecting point (whatever the number of interconnecting points within terminal and transit countries)	40	40	40	40	40	80
b) Charge per minute of transmission per terminal country	[a]	0.75	0.75	0.75	1.50	4.00
c) Charge per minute of transmission and per interconnecting point in a transit country	[a]	1.00	1.00	1.00	2.00	7.00
d) Charge per minute of transmission per 100 km of circuit	[a]	0.30	0.30	0.40	0.80	6.50
e) Special expenses	As appropriate					

[a] When a narrow-band circuit is used for transmission of a sound programme, the charge at b, c and d will be the telephone rate for manual operation in the relation concerned. When such a circuit is provided on a four-wire basis and used for supervision and for coordination in the reverse direction, a factor of 5/4 is applied to this charge.

Notes.

— A minimum chargeable duration of three minutes is applied for sound-programme transmission.

— The distance to be used for the charge for television circuits at d is the actual distance rounded up to the next multiple of 10 km.

— The figures given in this table do not take into account the different utilizations that can be made of the medium-band and wide-band circuits.

ANNEX 2
(to Recommendation E.330)

Former C.C.I.T.T. charges for continental-type sound and television programme transmissions

It is not yet possible to recommend specific charges for use within Europe and the Mediterranean Basin in accordance with 5.1, and cost studies will be undertaken to this end. However, some Administrations may wish to continue to apply the former charges pending such studies and relevant extracts from the former C.C.I.T.T. Recommendations E.330 and E.350 (*White Book*, Mar del Plata, 1968) are repeated below.

Sound-programme circuits

In fixing the following charges for continental sound-programme transmissions in the normal case in which programme transmissions are effected by means of "programme circuits", account has been taken of the cost elements established by the C.C.I.F., as the result of several studies, the last as recently as 1955.

		Old-type circuit (effective bandwidth transmitted: at least 50 to 6400 Hz)	Normal-type circuit (effective bandwidth transmitted: at least 50 to 10 000 Hz)
Charges for 3 minutes of sound programme transmission	Per 100 km (crowflight) of circuit	0.75 gold franc	0.75 gold franc
	For each international exchange (at the extremities of the connection)	0.75 gold franc	2.40 gold franc
Fixed surcharge, independent of the duration of the sound programme transmission		Equal to the charge for 8 minutes of sound-programme transmission, in the relation in question and by the circuit in question	
If, for their own purposes, Administrations wish to apply charges lower than those based on the above standards, this may be done by special agreement			

In the exceptional case in which a sound-programme transmission takes place over ordinary continental telephone circuits, the "charges for station-to-station calls" will apply, together with a surcharge corresponding to 8 minutes of telephone conversation in the charging period (period of heavy or light traffic) in which the programme transmission begins.

Television circuits

The provision of television circuits for continental television transmissions involves the Administrations in the construction of special and costly plant set aside for the purpose.

Studies of net costs of continental television circuits carried out in 1955-1956 took into account the cost of lines and of terminal equipment;

The costs of television lines on radio-relay links and in coaxial cables are sufficiently close to enable one amount to be used for either type of circuit;

The amounts of cost resulting from studies in 1955-1956 were based on the hypothesis of an average use of continental television circuits corresponding to an exchange of programmes (in both directions of transmission) between the two centres served by a circuit of 500 hours per annum;

This hypothetical duration of use is very much greater than the use actually made of television circuits in 1956;

Nevertheless, it is desired to give the maximum encouragement to the development of continental television exchanges by keeping the charges for them as low as possible;

It is therefore recommended:

— that the use of continental television circuits should be subject to the following charging rules;

— that the charge for 3 minutes' use of a continental television circuit, given below (being a charge somewhat less than the net cost on the basis of 500 hours' use per annum), could be revised when the use of television circuits increases substantially above an average of 600 hours' use per annum for television programmes in both directions of transmission between two centres.

The use of continental television circuits is subject to a charge and a surcharge.

a) The charge for each 3 minutes of use of such a circuit is 20 gold francs per 100 km of television line (crowflight). For each minute, or fraction of a minute, after the first 3 minutes of use, the charge is one-third of the above charge.

b) A surcharge is collected for each television transmission corresponding to 30 minutes' use of each television circuit actually used in the transmission in question. This surcharge is shared between the Administrations concerned on the same basis as the charge for the television transmission itself.

Special expenses

In addition, any special expenses which may be incurred by an Administration in extending continental television circuits from the continental terminal are also payable.

ANNEX 3
(to Recommendation E.330)

PBC
Sweden

Sweden
Programme Booking Centre

Swedish telecommunications Administration

Postal address	Televerkets Rundradiocentral, Kaknäs Box 27152 S-102 52 STOCKHOLM 27 Sweden
Telephone	Stockholm 63 14 80 ext. 126 or 128
Telex/Identification	Stockholm 1291 ruracen s Stockholm 1295 servcen s
Telegraphic address	Raracent Stockholm
Office hours (GMT)	May-Aug: Monday-Friday 0800-1600 Sept-April: Monday-Friday 0800-1640
Languages spoken	Swedish, English, French, German, Finnish
Senior staff and deputy	1. A. Nilsson 2. G. Holmgren
Contact outside office hours or on holidays	I.S.P.C. I.T.P.C. combined
Office handling orders for leased circuits (if other than P.B.C.)	Swedish telecommunications Administration Operational Department, Drr 2 S-123 86 FARSTA Sweden
Earth station	Tanum
Local time ref. GMT	+ 1
Name of customers (National Broadcasting Organization(s) etc.) for which orders normally are handled	Sveriges Radio (SR)
Notes:	

ANNEX 4
(to Recommendation E.330)

ITPC
Sweden

Sweden
International Television Programme Centre

Swedish telecommunications Administration

Postal address	Televerkets Rundradiocentral, Kaknäs Box 27152 S-102 52 STOCKHOLM 27 Sweden
Telephone	Stockholm 63 14 80
Telex/Identification	Stockholm 1291 ruracen s Stockholm 1295 servcen s
Telegraphic address	Ruracent Stockholm
Office hours (GMT)	0000-2400
Languages spoken	Swedish, English, French and German
Senior staff and deputy	1. A. Nilsson 2. Duty Engineer
Contact outside office hours or on holidays	—
Office handling orders for leased circuits (if other than P.B.C.)	Swedish telecommunications Administration Operational Department, Drr 2 S-123 86 FARSTA Sweden
Earth station	Tanum
Local time ref. GMT	+ 1
Name of customers (National Broadcasting Organization(s) etc.) for which orders normally are handled	Sveriges Radio (SR)
Notes:	

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CHAPTER 2

MAINTENANCE

1.1 International sound-programme transmissions—Definitions

Recommendation N.1

DEFINITIONS FOR APPLICATION TO INTERNATIONAL SOUND-PROGRAMME TRANSMISSIONS

The following definitions apply to international sound-programme transmissions:

a) *international sound-programme transmission*

The transmission of sound over the international telecommunication network for the purpose of interchanging sound-programme material between broadcasting organizations in different countries. Such a transmission includes all types of programme material normally transmitted by a sound broadcasting service, for example, speech, music, sound accompanying a television programme, etc.

b) *broadcasting organization (send)*

The broadcasting organization at the sending end of the sound programme being transmitted over the international sound-programme connection.

c) *broadcasting organization (receive)*

The broadcasting organization at the receiving end of the sound programme being transmitted over the international sound-programme connection.

d) *international sound-programme centre (I.S.P.C.)*

A centre at which at least one international sound-programme circuit terminates and in which international sound-programme connections can be made by the interconnection of international and national sound-programme circuits.

The I.S.P.C. is responsible for setting-up, lining-up and maintaining international sound-programme circuits and links, and for the supervision of the transmissions made on them.

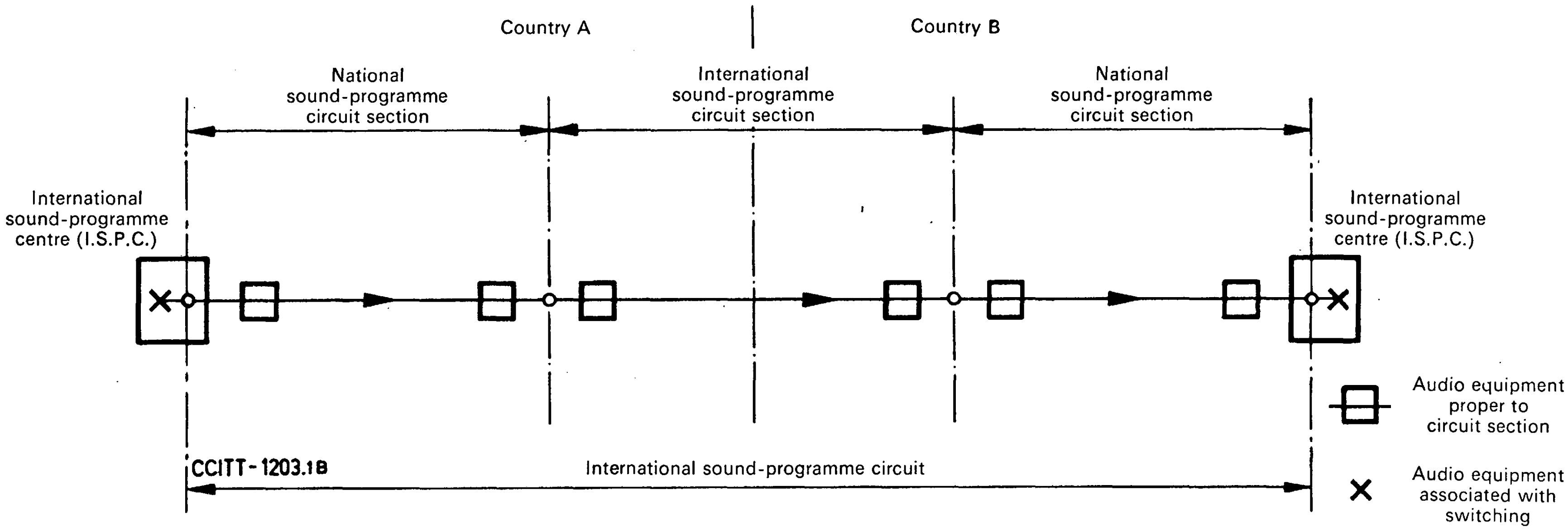


FIGURE 1/N.1. — **An international sound-programme circuit composed of two national and one international sound-programme circuit-sections.**

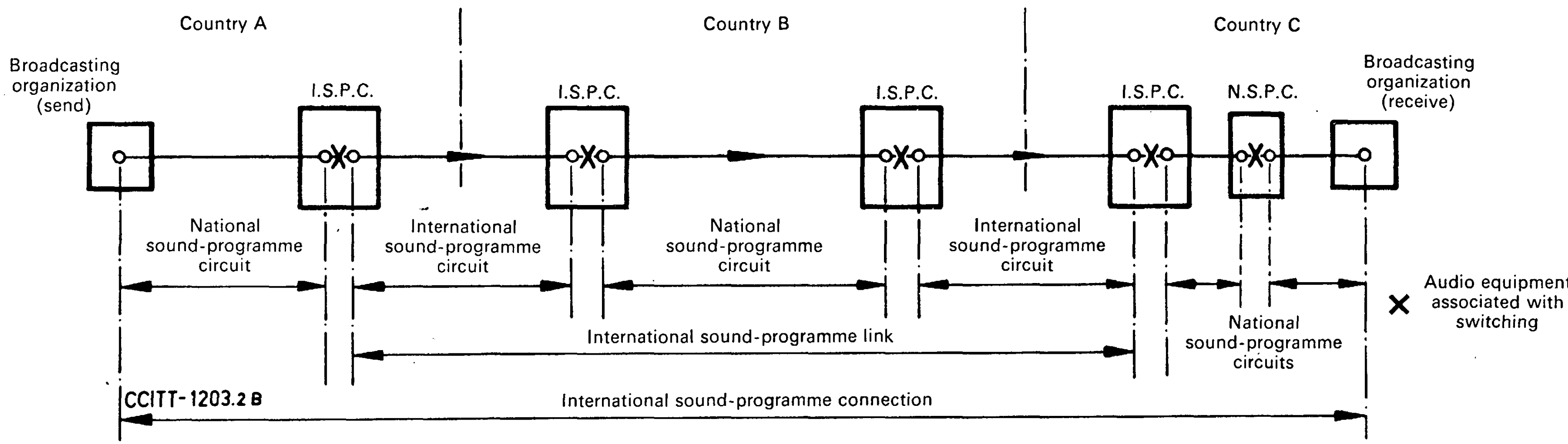


FIGURE 2/N.1. — **An international sound-programme link composed of international and national sound-programme circuits and extended on a national sound-programme circuit at each end to form an international sound-programme connection.**

e) *international sound-programme connection (Figure 2/N.1)*

The unidirectional path between the broadcasting organization (send) and the broadcasting organization (receive) comprising the international sound-programme link extended at its two ends over national sound-programme circuits to the broadcasting organizations.

f) *international sound-programme link (Figure 2/N.1)*

The unidirectional path for sound-programme transmissions between the I.S.P.C.s of the two terminal countries involved in an international sound-programme transmission. The international sound-programme link comprises one or more international sound-programme circuits interconnected at intermediate I.S.P.C.s. It can also include national sound-programme circuits in transit countries.

g) *international sound-programme circuit (Figure 1/N.1)*

The unidirectional transmission path between two I.S.P.C.s and comprising one or more sound-programme circuit sections (national or international), together with any necessary audio equipment (amplifiers, compandors, etc.).

h) *sound-programme circuit section (Figure 1/N.1)*

Part of an international sound-programme circuit between two stations at which the programme is transmitted at audio frequencies.

The normal method of providing a sound-programme circuit section in the international network will be by the use of carrier sound-programme equipment. Exceptionally sound-programme circuit sections will be provided by other means, for example, by using amplified unloaded or lightly loaded screened pair cables or by using the phantoms of symmetric pair carrier cables.

i) *effectively transmitted signals in sound-programme transmission*

For sound-programme transmission a signal at a particular frequency is said to be effectively transmitted if the nominal overall loss at that frequency does not exceed the nominal overall loss at 800 Hz by more than 4.3 dB. This should not be confused with the analogous definition concerning telephony circuits given in Recommendation G.151, A, Note 1 (Volume III of the *Green Book*).

For sound-programme *circuits* the overall loss (relative to that at 800 Hz) defining effectively transmitted frequency is 1.4 dB, i.e. about one-third of the allowance.

Recommendation N.2

DIFFERENT TYPES OF SOUND-PROGRAMME CIRCUIT

1. *Nominal bandwidth*

In referring to circuits for sound-programme transmission, the nominal bandwidth of the circuit or circuit-section is indicated by including the top nominal frequency in kilohertz that is effectively transmitted.

Example: 10 kHz sound-programme circuit.

2. *Types of sound-programme circuit*

The various types of international sound-programme circuit and circuit-section that can be envisaged are as follows [1]:

— 10 kHz
— 6.4 kHz
— 6.4 kHz old type

3. *Use of ordinary telephone circuits*

Although the use of ordinary telephone circuits for a sound-programme transmission ought to be avoided, exceptionally such circuits may be used for the transmission of spoken commentaries. However, it should be noted that the limits of the loss-frequency distortion cannot be guaranteed to be better than the limits shown in Recommendation M.58.

When a telephone circuit is used for a sound-programme transmission the terminating sets and the signalling equipment must be disconnected to avoid echo effects and false operation of the signal receiver.

When a telephone circuit is used for a sound-programme transmission, a point of zero relative level of the telephone circuit must coincide with a point of zero relative level on the sound-programme circuit (but see paragraph 2 of Recommendation N.15 in which it is pointed out that some Administrations have found it expedient to introduce a 6 dB difference in order to reduce the mean power level delivered to the telephone circuit).

Recommendation N.3

CONTROL CIRCUITS

1. *Definition of a control circuit*

A control circuit, which is a telephone circuit distinct from the special circuit for the sound-programme transmission, is paid for by the broadcasting organizations and provides them with a direct link between the programme source and the point where it is used (recording equipment, switching centre or broadcast transmitter).

In the case of television transmissions, the control circuits can be associated with sound-programme circuits set up for transmitting the sound of the television programme, or with the television circuits themselves. The broadcasting organizations then distinguish between:

— the " vision " control circuit,
— the " international sound " control circuit (for supervising the programme effects circuit provided for transmitting only the background noises of a programme),
— the " commentary " control circuit (for supervising the sound-programme circuit transmitting a commentary in a given language),
— the " complete programme " control circuit (for supervising the sound-programme circuit transmitting the whole of the sound part of a programme).

[1] The " 10 kHz ", " 6.4 kHz " and " 6.4 kHz old type " sound-programme circuits referred to above correspond respectively to what are called, in Volume III of the C.C.I.T.T. *White Book*:

— Normal programme circuits, type A,
— Normal programme circuits, type B,
— Old-type programme circuits.

2. *Provision of control circuits for sound-programme transmission* [1]

In providing control circuits for sound-programme transmission the following two types of transmission are considered:

— "regular transmissions", which are transmissions ordered once and for all, because they are to occur at regular intervals, at fixed times, on established links and always between the same points; and

— "occasional transmissions", which are transmissions not covered by the above definition.

These transmissions may each be direct sound-programme transmissions or multiple destination sound-programme transmissions.

The conditions governing the provisions and lease of control circuits for sound-programme transmissions are given in Recommendation E.330 of Volume II-A of the C.C.I.T.T. *Green Book.*

Recommendation N.4

DEFINITION AND DURATION OF THE LINE-UP PERIOD AND THE PREPARATORY PERIOD

For each international sound-programme transmission a distinction is made between:

— the *line-up period* during which the Administrations line up the international sound-programme link before handing it over to the broadcasting organizations;

— the *preparatory period* during which these broadcasting organizations do their own adjustments, tests and other work before the sound-programme transmission itself commences.

1. *Line-up period*

Duration

In principle, the duration of the line-up period should be 15 minutes. However, in the case of sound-programme transmissions involving more than two countries, the duration may be increased. On the other hand, in certain cases, by agreement between the Administrations concerned, the duration may be less than 15 minutes, provided the line-up is properly carried out. This may be possible, for example, when there are two successive international sound-programme transmissions on the same route and the second involves extending the international sound-programme link already lined up for the first.

Note. — In the case of sound-programme circuits required in association with a multiple television programme broadcast by several transmitters, the line-up period can have a longer duration, to be fixed by agreement between the Administrations concerned, e.g. of the order of 25 to 30 minutes.

At the end of the line-up period the international sound-programme link and the control circuits are handed over at the same time to the broadcasting organizations.

[1] The C.C.I.T.T. has noted the fact that broadcasting organizations use a tone having a frequency of 1900 Hz ± 6 Hz and a level not exceeding -10 dBm0, for their signalling purposes on control circuits. Under the conditions of use specified in the C.C.I.T.T. Recommendations for control circuits, the C.C.I.T.T. has no objections to the use of this tone.

2. *Preparatory period*

Beginning and duration

When the tests during the line-up period are completed, the " international sound-programme link " is not made available to the broadcasting organizations at the two ends until the time fixed for the beginning of the " preparatory period ". The chargeable time for the sound-programme transmission commences at the beginning of the preparatory period. The duration of the preparatory period — i.e. the time between handing over the international sound-programme link to the broadcasting organizations and the moment when the programme proper begins—is chosen in each case by the broadcasting organizations so that they can carry out all the tests and adjustments necessary before proceeding with the sound-programme transmission.

However:

— the duration of the preparatory period may be extended at the request of the broadcasting organization using the international sound-programme link;

— the duration of the preparatory period for sound-programme transmission may be extended by the Administrations concerned to more than a quarter of an hour in the case of complicated multiple transmissions (or sound-programme transmissions accompanying a multiple television programme), broadcast by several radio transmitters.

Recommendation N.5

CONTROL AND SUB-CONTROL STATIONS FOR SOUND-PROGRAMME CIRCUITS, CONNECTIONS, ETC.

1. *General*

For the establishment of a unidirectional international sound-programme circuit, the receiving end I.S.P.C. is the control station. The other terminal I.S.P.C. is a terminal sub-control station. If the international sound-programme circuit passes through one or more transit countries, an intermediate sub-control station is also designated for each transit country. The functions of the control and sub-control stations are the same as for ordinary telephone circuits. (See Recommendations M.8 and M.9.)

Note. — In the case of a reversible sound-programme circuit, setting-up reference measurements and maintenance measurements are carried out for each direction of transmission.

2. *Responsibilities*

2.1 The international sound-programme link is in all cases the sole responsibility of the telephone Administrations.

2.2 The national sound-programme circuits at the ends of the link may be the responsibility of either the Administrations or the broadcasting organization or the two together depending on local arrangements in each particular country.

2.3 The I.S.P.C. or the repeater station at the receiving end (country C in Figure 2/N.1) is normally a control station for the international sound-programme connection. However, the choice of the station having this function is left to the discretion of the Administration concerned.

2.4 The intermediate I.S.P.C.s are intermediate sub-control stations for the international sound-programme link.

2.5 The I.S.P.C. or the repeater station at the sending end (country A in Figure 2/N.1) is a terminal sub-control station for the international sound-programme connection.

However, the choice of the station having this function is left to the discretion of the Administration concerned.

1.2 Setting-up, lining-up, monitoring, charging and releasing the international sound-programme link

It is assumed that the international sound-programme link is as shown in Figure 1/N.11. It is also assumed that the various sound-programme circuits to be interconnected to constitute the international sound-programme link are permanent circuits (see sub-section 1.3 below).

Recommendation N.10

LIMITS FOR THE LOSS/FREQUENCY DISTORTION OF INTERNATIONAL SOUND-PROGRAMME CIRCUIT SECTIONS, CIRCUITS, LINKS AND CONNECTIONS

This Recommendation gives the limits, wherever possible, for the loss/frequency distortion of the various components of the connection shown in Figures 1/N.1 and 2/N.1. The limits are expressed in terms of the received level relative to the value of the received level at 800 Hz [1].

Some Administrations arrange their apparatus in an I.S.P.C. so that at the point of interconnection the output impedance of every receive channel or circuit over the frequency band of interest is substantially lower than the input impedance of any send channel or circuit. This is the so-called constant-voltage technique. Other Administrations arrange for an impedance match at the point of interconnection and choose the value of this impedance to be equal to the design resistance of measuring instruments—this is the impedance-matching technique (previously referred to as the constant electromotive force technique). It should be noted that in both cases the through-level measurement results relative to the through-level at 800 Hz will be the same [1]. Furthermore the terminated-level measurement results relative to the terminated-level at 800 Hz will also be this same value [2].

Hence the limits recommended in the following tables are applicable regardless of the arrangement adopted by Administrations at their I.S.P.C.s.

1. *Limits for loss/frequency distortion of sound-programme circuit sections*

It is not possible or desirable at this time to recommend limits for circuit-sections.

2. *Limits for loss/frequency distortion of international sound-programme circuits*

The following Tables A, B and C give the limits recommended for the various classes of international sound-programme circuit referred to in Recommendation N.2.

[1] For international circuits 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on many international circuits.

Multifrequency measurements made to determine, for example, the loss/frequency characteristic will include a measurement at 800 Hz, and therefore the reference frequency for such characteristics can still be 800 Hz.

[2] This depends on the ratio of the impedances on the send and receive sides at the various frequencies being sensibly constant. (See Recommendation N.11, paragraph 4.)

International sound-programme circuits set-up between I.S.P.C.s in any particular continent should usually be routed on a single group link (one circuit section, that is, one equipment for modulation from audio-frequencies and one for demodulation to audio-frequencies). Long international sound-programme circuits between I.S.P.C.s in different continents should not comprise more than three circuit sections.

TABLE A (N.10)

LIMITS FOR THE RECEIVED LEVEL RELATIVE TO THAT AT 800 Hz FOR A 10 kHz SOUND-PROGRAMME CIRCUIT

Frequency range	Received level relative to that at 800 Hz
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz	+0.6 to −1.4 dB
100 to 200 Hz	+0.6 to −0.9 dB
200 Hz to 6 kHz	+0.6 to −0.6 dB
6 to 8.5 kHz	+0.6 to −0.9 dB
8.5 to 10 kHz	+0.6 to −1.4 dB
Above 10 kHz	Not greater than 0 dB; otherwise unspecified

TABLE B (N.10)

LIMITS FOR THE RECEIVED LEVEL RELATIVE TO THAT AT 800 Hz FOR A 6.4 kHz SOUND-PROGRAMME CIRCUIT

Frequency range	Received level relative to that at 800 Hz
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz	+0.6 to −1.4 dB
100 to 200 Hz	+0.6 to −0.9 dB
200 Hz to 5 kHz	+0.6 to −0.6 dB
5 to 6 kHz	+0.6 to −0.9 dB
6 to 6.4 kHz	+0.6 to −1.4 dB
Above 6.4 kHz	Not greater than 0 dB; otherwise unspecified

TABLE C (N.10)

LIMITS FOR THE RECEIVED LEVEL RELATIVE TO THAT AT 800 Hz FOR A 6.4 kHz OLD-STYLE SOUND-PROGRAMME CIRCUIT

Frequency range	Received level relative to that at 800 Hz
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz	+0.6 to −1.4 dB
100 to 200 Hz	+0.6 to −0.9 dB
200 Hz to 3.2 kHz	+0.6 to −0.6 dB
3.2 to 5 kHz	+0.6 to −0.9 dB
5 to 6.4 kHz	+0.6 to −1.4 dB
Above 6.4 kHz	Not greater than 0 dB; otherwise unspecified

TABLE D (N.10)

LIMITS FOR THE RECEIVED LEVEL RELATIVE TO THAT AT 800 Hz FOR AN INTERNATIONAL SOUND-PROGRAMME LINK ESTABLISHED WHOLLY ON 10 kHz SOUND-PROGRAMME CIRCUITS

Frequency range	Received level relative to that at 800 Hz
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz	+1.8 to −4.2 dB
100 to 200 Hz	+1.8 to −2.7 dB
200 Hz to 6 kHz	+1.8 to −1.8 dB
6 to 8.5 kHz	+1.8 to −2.7 dB
8.5 to 10 kHz	+1.8 to −4.2 dB
Above 10 kHz	Not greater than 0 dB; otherwise unspecified

TABLE E (N.10)

LIMITS FOR THE RECEIVED LEVEL RELATIVE TO THAT AT 800 Hz FOR A SOUND-PROGRAMME LINK COMPOSED WHOLLY OF 6.4 kHz SOUND-PROGRAMME CIRCUITS

Frequency range	Received level relative to that at 800 Hz
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz	+1.8 to −4.2 dB
100 to 200 Hz	+1.8 to −2.7 dB
200 Hz to 5 kHz	+1.8 to −1.8 dB
5 to 6 kHz	+1.8 to −2.7 dB
6 to 6.4 kHz	+1.8 to −4.2 dB
Above 6.4 kHz	Not greater than 0 dB; otherwise unspecified

Modern carrier sound-programme equipment for a 10 kHz sound-programme circuit can easily meet the characteristic proposed above in Table A. Furthermore, experience shows that such a characteristic can easily be met by a circuit provided on equalized unloaded cable pairs up to 320 km long. Hence the adoption of this characteristic as a target for the future should not be embarrassing. Some older types of carrier sound-programme equipment will probably need additional equalizers to comply with the limits. When a circuit is to be equalized, the opportunity should be taken to obtain as good a level frequency characteristic as possible.

3. *Limits for the loss/frequency distortion on an international sound-programme link*

The Tables D and E give the limits for two types of international sound-programme links. Table D is for a link established wholly on 10 kHz circuits and Table E for a link established wholly on 6.4 kHz circuits.

The majority of international sound-programme links are in practice established with three or less circuits in series and the limits recommended for a link are accordingly three times those recommended for a circuit.

Many links could be established without additional equalizers but links comprising four or more circuits will probably require equalization in which case opportunity could again be taken to obtain as good a loss/frequency characteristic as possible.

4. *Limits for the loss/frequency distortion of an international sound-programme connection*

It is not possible at the present time to recommend limits for the sound-programme connection but every effort should be made by Administrations to provide national sound-programme circuits to as high a standard as possible so that the loss/frequency distortion of the sound-programme connection is not markedly more than that of the sound-programme link.

Recommendation N.11

ESSENTIAL TRANSMISSION PERFORMANCE OBJECTIVES FOR INTERNATIONAL SOUND-PROGRAMME CENTRES (I.S.P.C.)

1. *Transmission level at interconnection points*

The nominal relative level at interconnection points is not specified by the C.C.I.T.T. and Administrations are free to decide the level themselves, bearing in mind, among other things, the need to ensure an adequate signal-to-noise ratio within the I.S.P.C. However, levels at interconnection points must be such that a signal level of 0 dBm0 on the incoming circuit gives rise to a signal level of 0 dBm0 on the outgoing circuit. It should be noted that many Administrations, particularly those which have adopted so-called constant-voltage techniques, have chosen a nominal relative level of +6 dBr at which to interconnect. Figure 1/N.11 and the supporting text is an example of an international sound-programme connection in which each Administration has chosen interconnection points to have a nominal relative level of +6 dBr. However, other Administrations have chosen other levels.

2. *Balance with respect to earth*

The balance with respect to earth (measured by the method defined in Figure 4B, Annex 3, *Blue Book*, Volume III) of nominally balanced apparatus should be at least 60 dB in order to give an adequate suppression against longitudinal interference induced by power supplies, alarm circuits, etc.

3. *Access-points*

There should be a well-defined circuit access-point associated with the input to a sound-programme circuit at which the transmission test levels at all frequencies over the band are nominally the same. This access-point may be the interconnection point or separated therefrom by distortion-free loss or gain. A well-defined circuit access-point should also be associated with the output of a sound-programme circuit.

The nominal relative level at each access-point will be chosen by each Administration, bearing in mind the dynamic range of their testing and transmission apparatus.

Measurements on a sound-programme circuit should be made between such circuit access-points.

Administrations may also find it convenient to arrange for sound-programme circuit sections to be equipped with similar access-points. *International* sound-programme circuit sections which can be connected to a variety of other circuit sections should always be equipped with such access-points.

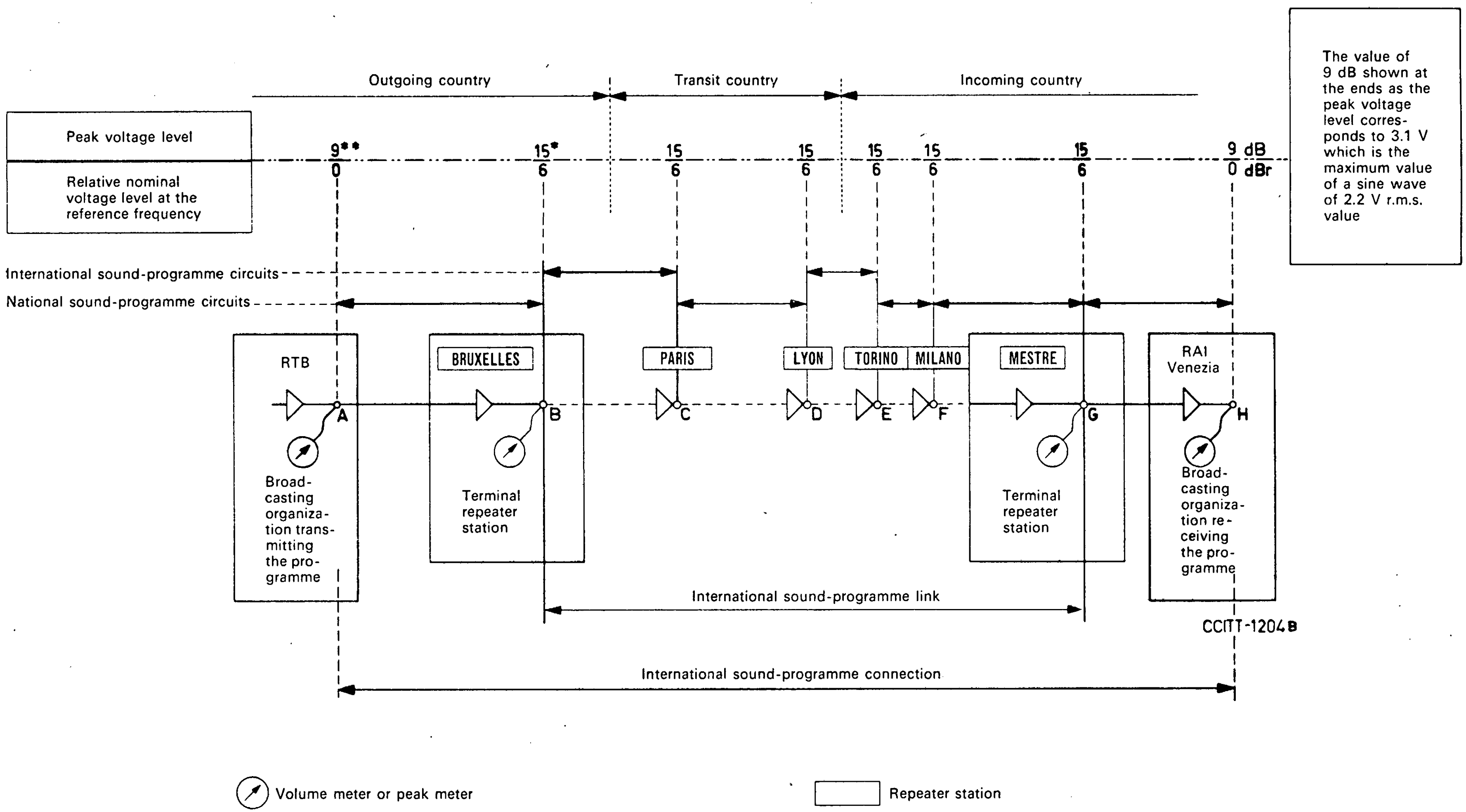
4. *Impedance at sound-programme interconnection points*

a) *Constant voltage technique*

If the modulus of the output impedance of any source is not greater than one-hundredth of the modulus of the lowest impedance that can be connected to it (bearing in mind that it is possible to connect two or more loads in parallel) then the change in level due to change of load will be negligibly small (less than 0.1 dB approximately).

b) *Impedance matching technique*

If the return loss versus the nominal design resistance of the measuring instruments of the impedance presented by incoming and outgoing circuits to the points where they are interconnected is at least 26 dB



* These levels are appropriate to national sound-programme circuits in the countries concerned

** The RTB in fact adopts levels of 15/6 at this point

FIGURE 1/N.11. — **Diagram of an international sound-programme connection in which all the countries concerned have chosen +6 dBr as the nominal relative level at points at which circuits are interconnected.**

over the range 50 Hz to 10 kHz, the error due to mismatch will be insignificant, assuming that the impedance of testing apparatus has at least 30 dB return loss versus the nominal design resistance, which can be, for example, 600 ohms non-reactive.

5. *Example of a through-level diagram of an international sound-programme connection on which every Administration has chosen to interconnect circuits at a relative level of +6 dBr (nominal value)*

5.1 It is assumed that the international sound-programme link is as shown in Figure 1/N.11 and that the various sound-programme circuits to be interconnected to constitute the international sound-programme connection are permanent circuits which are subjected to routine maintenance.

5.2 The through-level diagram referred to is that of the international sound-programme connection and not that of the sound-programme circuits. In this example the levels quoted are in all cases measured as 600 ohm through-levels.

5.3 On this through-level diagram:

a) the ends (sending or receiving) of a national or of an international sound-programme circuit are, in principle, those points at which it is intended that the circuit should be interconnected with other national or international sound-programme circuits;

b) the reference point for relative levels is normally the sending end of the international sound-programme connection, namely point A in Figure 1/N.11 (a different convention may be adopted by agreement between the telecommunication Administration and the broadcasting organizations in one and the same country, provided that the through-levels on the international sound-programme link are not modified thereby);

c) the nominal value of 600 ohm through-level measured at the receiving end of each of the international sound-programme circuits included in the constitution of the international sound-programme link (for example, points C and E of Figure 1/N.11) is 6 dB above the nominal value at the sending end of the international sound-programme connection; in other words, if at the sending end of the international sound-programme connection, this being a zero relative level point, there is a sinusoidal signal producing an r.m.s. value of 0.775 volt across the circuit at that point, the 600 ohm through-level at C and E must be +6 dB (that is, its r.m.s. value must be 1.55 volts);

d) the nominal value of the 600 ohm through-level at the sending end of an international sound-programme circuit (for example, point B of circuit BC, point D of circuit DE) is also +6 dB.

5.4 For such an international sound-programme connection for which the Administrations have chosen a nominal value of +6 dB as the relative level at which they interconnect circuits, the setting-up and maintenance measurements made by the telephone Administrations are always carried out by sending at the input to the international sound-programme link a 600 ohm through-level of −6 dB at the reference test frequency (800 or 1000 Hz) and at all other test frequencies.

Recommendation N.12

MEASUREMENTS TO BE MADE DURING THE LINE-UP PERIOD THAT PRECEDES A SOUND-PROGRAMME TRANSMISSION

The national sound-programme circuits should be so adjusted that, when they are connected to the international sound-programme link, the level diagrams of the international sound-programme circuits are respected.

After the connection of the various circuits to form the international sound-programme link (conforming to the level diagrams of these circuits) it is necessary to verify, by means of an automatic measuring equipment (see Recommendation O.31) or by measurements at individual frequencies, that the received level at the distant incoming terminal I.S.P.C. is at the correct value at the following frequencies:

for an international sound-programme link composed entirely of 10 kHz sound-programme circuits	50, 800 and 10 000 Hz
for an international sound-programme link comprising at least one 6.4 kHz or 6.4 kHz old-type sound-programme circuit	50, 800 and 6400 Hz
for an international sound-programme link comprising at least one ordinary telephone circuit	300, 800 and 3400 Hz [1].

A measurement of the noise power level should be made on all links in the same manner as given for circuits in Recommendation N.21, paragraph c and the results recorded. At the present time limit values cannot be specified for maintenance purposes.

Any necessary adjustments having been made, the national circuits are connected to the international sound-programme link at the terminal I.S.P.C.s. This is the end of the line-up period and the beginning of the preparatory period and is the instant when the complete connection is placed at the disposal of the broadcasting organizations.

The latter then proceed to measure and adjust as necessary.

Recommendation N.13

MEASUREMENTS TO BE MADE BY THE BROADCASTING ORGANIZATIONS DURING THE PREPARATORY PERIOD

After the broadcasting organizations have taken possession of the international sound-programme connection, they make measurements on the complete connection in the band of frequencies effectively transmitted, from the point where the programme is picked up to the point where the programme is received.

The broadcasting organizations should, for their measurements, send to the origin of the international sound-programme connection a sinusoidal signal at the reference frequency (800 or 1000 Hz) only, whose maximum amplitude is 9 dB below that of the maximum instantaneous voltage that should never be exceeded at this point in the course of a sound-programme transmission.

The duration of the period during which the signal at this level is sent should be kept as short as possible, for example of the order of 30 seconds. If necessary, the I.S.P.C.s should verify that the received level at the access-point on the international sound-programme circuit is equivalent to 0 dBm0.

When it is necessary, either for purposes of fault location or to maintain a watch on the continuity of the circuit, to send a continuous tone, or when making measurements at other frequencies than the reference frequency, the amplitude at the origin of the international sound-programme connection should be 21 dB below the " voltage that should never be exceeded " at this point during the course of a sound-programme transmission. Under these circumstances the level at the access-point on the international sound-programme circuit is equivalent to −12 dBm0.

During the preparatory period there is no occasion to readjust the output levels at intermediate I.S.P.C.s since these have already been set during the line-up period.

[1] Or the frequency appropriate to the telephone circuit used.

Note. — The numerical values given above ensure that during the sound-programme transmission the peak voltage at a zero relative level point will not exceed that of a sinusoidal signal having an r.m.s. value of 2.2 volts.

The reason for sending the reference frequency only for short durations during this final line-up, at a voltage 9 dB below the peak voltage is that it is not desirable to subject carrier systems to overloading by continuously transmitting a test signal corresponding to the peak voltage reached only momentarily during the transmission of an actual programme.

Recommendation N.15

MAXIMUM PERMISSIBLE POWER DURING AN INTERNATIONAL SOUND-PROGRAMME TRANSMISSION

General

To check that the maximum power transmitted during a sound-programme transmission does not exceed the limits allowed by Administrations, it is recommended that broadcasting organizations and the terminal I.S.P.C.s of the international sound-programme connection should use volume-meters or peak programme meters, the same type of meter being used for preference by both the telephone Administration and the broadcasting organization of a country.

Since the international sound-programme connection is accurately adjusted before it is made available to the broadcasting organizations, there will be no danger of overloading the amplifiers during the sound-programme transmission if care is taken not to exceed the permissible limit at the sending end of the international sound-programme connection.

Hence, this check can be done only by the broadcasting organization and the I.S.P.C. of the transmitting country, and a check made further down the line would not seem to be very effective.

If so desired, monitoring equipment (volume-meters, peak-indicators) can be connected at the receiving end of the international sound-programme link and of the international sound-programme connection to obtain information about the general nature of the transmission. In this case, monitoring equipment at the two locations in the incoming country will have to be of the same type, but there is no need for the same kind of monitoring equipment to be used in both outgoing country and incoming country.

1. *Maximum level permitted on sound-programme circuits*

The peak power permitted on a sound-programme circuit should not exceed +9 dBm at a point of zero relative level on the sound-programme circuit.

(This corresponds to a peak voltage of 3.1 volts when measured as a 600 ohm through-level at a zero through relative level point. The r.m.s. value of the sinusoidal signal with this peak value is 2.2 volts.)

2. *Maximum level permitted on an international telephone circuit used to carry a sound-programme transmission*

The power permitted on the international telephone circuit carrying a sound-programme transmission should not exceed +9 dBm at a point of zero relative level on the international telephone circuit. In effect this permits zero relative points on the telephone circuits and the sound-programme circuit to be directly joined together without gain (from sound-programme circuit to telephone circuit) but with or without loss.

Note. — The sound-programme transmission usually carried by international telephone circuits used in this way is a spoken commentary; music, for example, would in general be seriously distorted by the restricted bandwidth of the telephone circuit. For such speech, a *peak* value of power of + 9 dBm corresponds to a long-term *mean* power of about −6 dBm. Bearing in mind that for international line systems designed according to C.C.I.T.T. Recommendations, a long-term mean power per channel of −15 dBm (at a zero relative point) is assumed, some Administrations have deemed it advisable to reduce the permitted peak power of any sound-programme signals carried by international telephone circuits under their control to a value not exceeding + 3 dBm at a point of zero relative level on the telephone circuit. Thus in effect a 6 dB loss is introduced between the zero relative points of the sound-programme circuit and the international telephone circuit and this has the effect of reducing the mean speech power under these conditions to a value closer to the system design value. It should be borne in mind that the margin against crosstalk from other telephone channels into the telephone channel carrying the sound-programme is reduced by this technique. In particular, the return channel of the telephone circuit carrying the sound-programme can become a source of crosstalk. However, the improved go-to-return crosstalk attenuation of modern channel-translating equipment (necessary, if a speech concentrator is used) provides an opportunity to reduce the sound-programme level without incurring crosstalk trouble.

Recommendation N.16

IDENTIFICATION SIGNAL

During the preparatory period, at times when no test transmission is taking place, to indicate that the circuits are through, it is very desirable for broadcasting organizations to arrange that their studios and transmitting stations send " identification signals " over the international sound-programme connection and over the control circuits whilst they are not in use. During the preparatory period, particularly, the identification signal will serve to show for which sound-programme transmission the circuit is to be used.

This identification signal will not be broadcast, so that it will not be heard by listeners, but will be transmitted from end to end of the international sound-programme connection, from the outside broadcast point to the destination (I.S.P.C., radio transmitter centre or recording centre).

The level of the identification signal applied to a sound-programme connection should not exceed a mean absolute power level of −15 dBm0.

Recommendation N.17

MONITORING THE TRANSMISSION

The transmission may be monitored in the terminal I.S.P.C.s either by means of loudspeakers and/or apparatus with a visual display (peak programme meters, v.u. meters, oscilloscopes, etc.). The means for monitoring the transmission should give both visible and audible indications.

Recommendation N.18

MONITORING FOR CHARGING PURPOSES, CLEARING DOWN

The monitoring of an international sound-programme transmission for charging purposes is carried out at the terminal I.S.P.C. of the international sound-programme link.

The technical staff of the designated I.S.P.C.s should come to an arrangement among themselves so that at the end of the sound-programme transmission they have accurate knowledge of:

a) the time of handing over the sound-programme link to the broadcasting organization (beginning of chargeable duration);

b) the time at which the sound-programme link is released by the broadcasting organization (end of chargeable duration);

c) where appropriate, the times and duration of every interruption or incident which may have occurred (in order to allow the operating services to determine whether a rebate is due, and if so, its amount).

The times of the beginning and of the end of the chargeable duration, as well as the times of occurrence and duration of any breakdowns which may occur, are entered on a daily report. This daily report is sent on the same day to the service responsible for coordinating all the details necessary for the establishment of the international accounts.

The conditions governing charging for sound-programme circuits and control circuits are given in Recommendation E.330 of Volume II-A of the *Green Book*.

1.3 Setting-up and lining-up of permanent international circuits for sound-programme transmissions

Recommendation N.21

SETTING-UP AND LINING-UP THE CIRCUIT

When each national section of the international sound-programme circuit and each section crossing a frontier has been equalized for loss/frequency distortion and, where necessary, for phase/frequency distortion, so as to meet C.C.I.T.T. Recommendations, these various sections are interconnected to form the complete international sound-programme circuit, and the following measurements are made:

a) *Measurement of received level*

A test signal of 800 Hz is applied to the sending end of the international sound-programme circuit at a level equivalent to −12 dBm0. The level is measured at the receiving end of the circuit (output of last amplifier) and is adjusted to the nominal value appropriate to the I.S.P.C. (for example, −6 dBm).

An automatic measuring equipment (see Recommendation O.31) may then be used to trace the curve of received level with frequency at the receiving end of the circuit. If no such equipment is available, individual measurements must be made at the terminal I.S.P.C. and at the frontier station at the following frequencies:

- for a 10 kHz circuit: 50, 80, 100, 200, 500, 800, 1000, 2000, 3200, 5000, 6000, 8500, 10 000 Hz; and if considered useful: 30, 40, 11 000, 12 000 and 15 000 Hz;
- for a 6.4 kHz circuit and for a 6.4 kHz old-type circuit: 50, 80, 100, 200, 500, 800, 1000, 2000, 3200, 5000 and 6400 Hz.

The equalizers are adjusted to bring the curve within C.C.I.T.T. limits, which are given in Recommendation N.10.

b) *Measurement of group-delay distortion*

If necessary, the group-delay distortion/frequency characteristic is plotted for the whole international sound-programme circuit.

c) *Measurement of circuit noise*

When, after all necessary adjustments, the international sound-programme circuit meets the C.C.I.T.T. Recommendations, noise measurements are made.

These should consist of:

- measurement of the unweighted noise voltage at the end of the international sound-programme circuit, using a measuring set having a frequency range of about 30 to 20 000 Hz, an instrument showing r.m.s. values and an integrating time of about 200 ms;
- measurement of the weighted psophometric noise voltage, using a sound-programme circuit psophometer (see the weighting curve of this psophometer in Supplement No. 3.2 in this volume).

The following are the limiting values at a point of zero relative level for various types of circuit for a length of about 2500 km:

Measurement	Cable circuit	Open-wire line
Unweighted voltage—	31 mV	78 mV
Psophometric voltage—	3.1 mV	7.8 mV

Note. — When measuring noise levels there may be cases when the noise values given by a psophometer are within those stated in the table and the unweighted noise values are not within the limits in the table or vice versa, so that a psophometric noise level exceeds the given standard and an unweighted noise level is within the limits. This shows the presence of a single tone interference of high level. In such a case the maintenance staff should, by means of a selective set, determine the frequency of this interfering signal and take measures to eliminate it. When only flat noise is present the ratio of the noise to the psophometric noise is 1: 2 (6 dB).

For convenience, the table below gives the voltages at a +6 dBr point and also the quantities in transmission units corresponding to the above limits.

With a 600 ohm instrument		Power level at a 0 dBr point
Voltage at a 0 dBr point	Voltage at a +6 dBr point	
(mV)	(mV)	dBm0
78	156	−20
31	62	−28
7.8	15.6	−40
3.1	6.2	−48

d) *Measurement of non-linearity distortion*

For circuits routed entirely on audio pairs and not equipped with pre-emphasis equipment the non-linearity distortion is measured at the end of the international sound-programme circuit by sending for a few seconds a sinusoidal signal at an appropriate frequency in the band to be transmitted at a level of +9 dBm0.

For a circuit which includes at least one carrier section no measurement of non-linearity distortion should be made. However, if, in very exceptional cases, it should be essential, in order to provide service on such a circuit, to carry out a check of non-linearity distortion, for example, to locate a fault, the frequency of the sent signal should not exceed 1000 Hz at +9 dBm0 and the period for which the tone is connected should be as short as possible—that is, not more than about four seconds. However the best procedure would be to use a suitable automatic measuring equipment if such is available (see Recommendation O.31).

The total harmonic-distortion coefficient for the sound-programme hypothetical reference-circuit (2500 km) must not exceed 4% (harmonic margin 28 dB) at any frequency [1] within the transmitted band. For shorter and for less complex circuits, the distortion should be less.

[1] The European Broadcasting Union has stated that many of its members have expressed the opinion that for a circuit 1500 km long, acceptable limits for non-linearity distortion would be:
40 dB at fundamental frequencies above 100 Hz,
34 dB at fundamental frequencies of 100 Hz and below.

Moreover, since end-to-end measurements of non-linearity distortion on circuits routed on carrier systems might give rise to serious disturbance to transmission on other channels, especially if the group is transmitted on a transistorized carrier system, it is permitted to make only local measurements of non-linearity distortion on terminal modulating and demodulating equipments. For example, a sound-programme circuit modulating and demodulating equipment could be connected back-to-back via a suitable network (and suitable amplifiers if necessary) and the measurement made on the resulting complete assembly.

e) *Record of results*

The final measurements made under the above headings when the circuit has been lined-up are reference measurements and should be carefully recorded.

Recommendation N.22

REFERENCE MEASUREMENTS ON INTERNATIONAL SOUND-PROGRAMME CIRCUITS

The received level at the terminal I.S.P.C. and at the frontier station is measured at the following frequencies:

— for a 10 kHz circuit: 50, 80, 100, 200, 500, 800, 1000, 2000, 3200, 5000, 6000, 8500, 10 000 Hz; and if considered useful: 30, 40, 11 000, 12 000 and 15 000 Hz;

— for a 6.4 kHz circuit and for a 6.4 kHz old-type circuit: 50, 80, 100, 200, 500, 800, 1000, 2000, 3200, 5000 and 6400 Hz

and these measurements constitute the reference measurements.

The results of these measurements are carefully recorded on a line-up record [1] and also the values of unweighted noise and psophometric voltage measured at the end of the international sound-programme circuit.

[1] See, as example, the model in the Appendix to this Recommendation.

APPENDIX
(to Recommendation N.22)

Line-up record for an international sound-programme circuit

Technical service of: Suisse
Circuit designation: Stuttgart–Zürich R 3
Control station: Zürich
Sub-control station: Stuttgart
Type of circuit: 10 kHz
Date of commissioning: 2 September 19..
Issue dated: 1 October 19..
Level frequency characteristic
Levels measured at a +6 dBr point with a level of −12 dBm0

Frequency (Hz)	600 ohm through level (in decibels) when 0.775 volt is applied at the (two-wire) sending end		
	Horb	Donaueschingen	Zürich
30 [a]	−6.0	−5.7	−6.2
40 [a]	−5.9	−5.7	−6.2
50	−5.9	−5.6	−6.2
80	−5.8	−5.6	−6.0
100	−5.6	−5.6	−5.9
200	−5.6	−5.5	−5.8
500	−5.6	−5.4	−5.8
800	−5.7	−5.4	−5.7
1 000	−5.8	−5.4	−5.6
2 000	−5.6	−5.4	−5.6
3 200	−5.6	−5.5	−5.6
5 000	−5.6	−5.6	−5.6
6 000 [b]	−5.7	−5.6	−5.7
6 400 [c]			
8 500 [b]	−5.8	−5.7	−5.9
10 000 [b]	−5.9	−5.9	−6.1
11 000 [a]			
12 000 [a]			
15 000 [a]			

Noise: Psophometric noise 2.4 mV, Flat unweighted noise 19 mV } at a +6 dBr point.

[a] Measurements at these frequencies will be made only if considered useful.
[b] 10 kHz sound-programme circuits only.
[c] 6.4 kHz and 6.4 kHz old-type sound-programme circuits.

Recommendation N.23

ROUTINE MAINTENANCE MEASUREMENTS TO BE MADE ON INTERNATIONAL SOUND-PROGRAMME CIRCUITS

1. The following routine maintenance measurements should be made *every two months:*

a) *Measurement of received level*

The level at the end of the international sound-programme circuits should be measured at the following frequencies:

— for a 10 kHz circuit: 50, 100, 200, 800, 3200, 5000, 6000, 8500 and 10 000 Hz;

— for a 6.4 kHz circuit and for a 6.4 kHz old-type circuit: 50, 100, 200, 800, 3200, 5000 and 6400 Hz.

After this measurement, the level at 800 Hz is adjusted, if necessary, to its nominal value.

If it is found that the level for a particular frequency at the receiving end of the international sound-programme circuit is not within the specified limits, the reference measurements should be repeated, calling in the frontier stations to determine the faulty sections. Further overall measurements are then made to ensure that the specified limits are respected.

b) *Measurement of circuit noise*

At the time of the two-monthly maintenance measurements, the noise at the receiving end of the international sound-programme circuit should be measured using the C.C.I.T.T. programme circuit psophometer (see the weighting curve for this psophometer in Supplement No. 3.2 of this volume of the C.C.I.T.T. *Green Book*).

c) *Measurement of non-linearity distortion*

After measurements of level have been made and any necessary adjustment has been carried out, the non-linearity distortion should be measured, to ensure that the circuit concerned can transmit sound-programme signals with the required quality.

Measurements are made under the conditions described in Recommendation N.21 above, paragraph d, and with the same restrictions concerning circuits on carrier groups or equipped with emphasis networks.

Provisionally, the C.C.I.T.T. recommends the use of a measuring instrument that indicates total harmonic power rather than a selective instrument of the wave-analyzer type with which the final value of harmonic margin is obtained only after much calculation.

d) *Release of circuit for routine measurements*

Notwithstanding any understanding with a renter that routine tests shall, in general, be carried out at certain times, the I.S.P.C. must agree with the renter of a permanently leased circuit on the time that that circuit shall be taken for tests each time a routine test is to be carried out.

2. Where routine measurements are made using automatic measuring equipment (see Recommendation O.31), the requirements of 1. above should be met.

1.4 Setting-up and lining-up of sound-programme circuits used on an occasional basis

Recommendation N.30

SETTING-UP AND LINING-UP OF SOUND-PROGRAMME CIRCUITS ROUTED ON COMMUNICATION SATELLITE SYSTEMS

A. Single destination circuits

1. *General*

Sound-programme circuits such as those associated with television transmissions using communication satellite systems can be provided on an occasional basis. The international sound-programme circuit section is established via the satellite link(s) each time it is required for service. The international sound-programme circuits and links when established via a satellite link should meet the transmission requirements given in Recommendation N.10.

Figure 1/N.30 shows the basic composition for a single destination international sound-programme circuit routed via a communication satellite. It should be noted that the group carrying the sound-programme circuit may terminate either at the earth section or at an international terminal repeater station.

2. *Initial setting-up of the international sound-programme circuit*

2.1 When agreement has been reached between two countries, operating via a communication satellite, to provide sound-programme circuits on an occasional basis, it is necessary to carry out an initial line-up of the sound-programme circuit using the same satellite and terrestrial facilities as will be used each time a sound-programme transmission is required.

2.2 *Initial setting-up procedure*

a) *Setting-up the basic group carrying the sound-programme circuit*

This should be carried out in accordance with Recommendation M.46.

The possible combination of group-terminals and the number of group-sections required for single-destination sound-programme circuits are such that it may not be possible to meet the group-link limits without group-link equalization for each sound-programme circuit set-up.

To avoid this situation, it may become necessary to tighten the limits for the loss at all frequencies and for the loss at the approximate mid-band frequency of the national and satellite group-sections.

b) *Setting-up the international sound-programme circuit*

This should be carried out in accordance with Recommendation N.21.

3. *Pre-transmission setting-up of the international sound-programme circuit*

3.1 All international sound-programme circuits set up on an occasional basis should utilize the same line and terminal equipment as was used in the initial setting-up of the circuit. Prior to each transmission the occasional-use carrier, the basic group and the international sound-programme circuit have to be re-established.

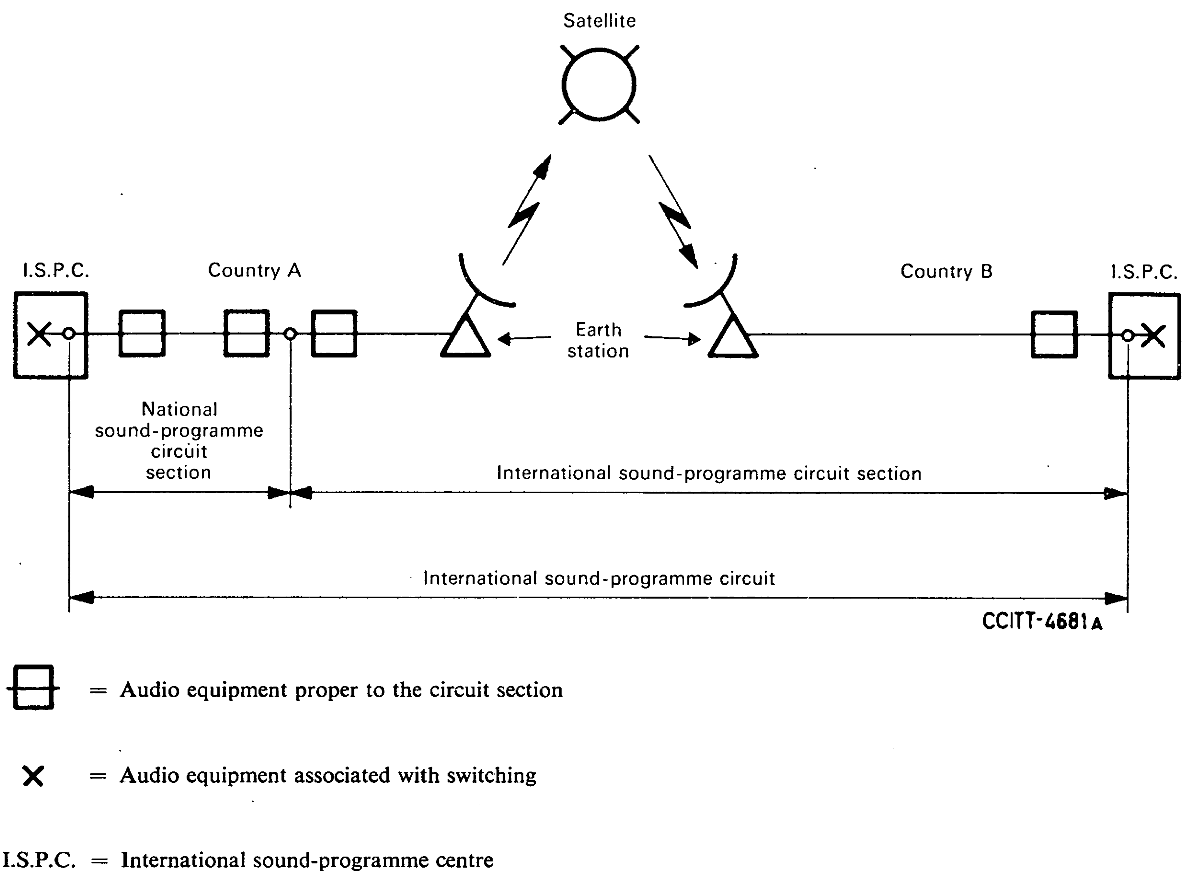


FIGURE 1/N.30. — **Single-destination international sound-programme circuit routed via a communication satellite.**

3.2 *Pre-transmission setting-up procedure*

a) *Setting-up the basic group carrying the international sound-programme circuit*

A check of pilot levels in both directions of transmission should be made to ensure that they are in accordance with M.46.

b) *Setting-up the international sound-programme circuit*

This should be carried out in accordance with Recommendation N.12.

B. MULTIPLE DESTINATION CIRCUITS

1. *General*

Sound-programme transmissions can be provided on a multiple destination basis using a communication satellite system. These transmissions differ from those using only terrestrial facilities in that the common transmitting path extends through the transmitting earth station to thc satellite. The receiving paths extend from the satellite through the receiving earth stations concerned to the terminal I.S.P.C. control stations.

Operations on the common path of the connection affect all receiving stations, whereas operations on any of the other paths affect only the one receiving terminal station involved. These distinctive features of a multiple destination sound-programme transmission provided in the above manner require the assistance of certain stations designated as " send reference " stations, having responsibilities additional to those normally provided by their status under Recommendation N.5.

Figure 2/N.30 shows the basic composition for a multiple sound-programme circuit routed via a communication satellite. The send reference stations are shown as R and R′.

Figure 3/N.30 shows the composition for a multiple destination sound-programme link and connection routed via a communication satellite.

" Send reference " stations

" Send reference " stations are situated along the common path of the sound-programme circuit or link and are identified as follows:

a) a sub-control station located at the transmitting terminal of the circuit section containing the space segment;

b) the terminal sub-control stations for the circuit and link containing the space segment.

In addition to the responsibilities laid down by Recommendation N.5, for the designated " send reference " stations the following responsibilities apply:

i) Coordination of lining-up the multiple-destination sound-programme circuit sections, circuits and links, respectively.

ii) Keeping a record of the measurements made during the lining-up period of the circuit section, circuit or link, and recording the quality assessments observed at control stations during the lining-up of the link.

iii) Relevant maintenance action for the sub-control and control stations when called upon to do so by one of these stations.

Control stations

The receiving I.S.P.C. stations on multiple destination sound-programme circuits or links act as control stations for the circuit or link. The responsibilities of these stations are given in Recommendation N.5.

The following additional responsibilities should apply:

i) Reporting to the appropriate " send reference " station the results of measurements made on the circuit and link and the quality assessments observed on the link.

ii) Reporting fault conditions to the circuit or link " send reference " station.

2. *Setting-up the multiple-destination international sound-programme circuit*

2.1 In the case of multiple-destination international sound-programme circuits, the number and location of all destinations is known only at the time of a transmission booking. The setting-up and lining-up can therefore be carried out only after the booking details are known and must be carried out prior to the transmission.

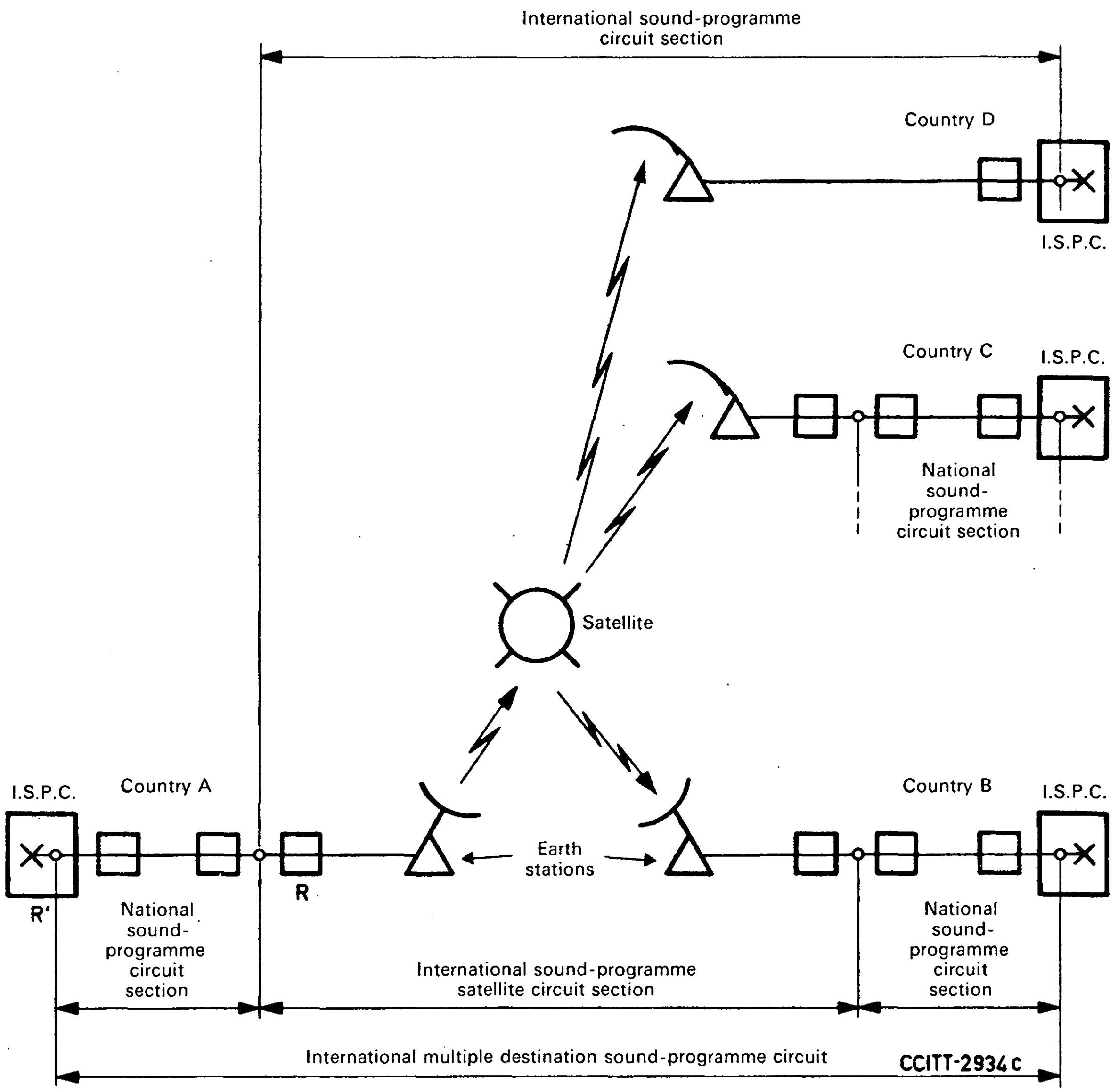
2.2 *Setting-up procedure*

a) *Setting-up the multiple destination group carrying the international sound-programme circuit*

The individual basic groups will have been set up and lined up for single destination sound-programme circuit requirements. When these are formed into a multiple-destination group, only pilot levels need be checked. The " send reference " station for the MU group will coordinate this work in accordance with Recommendation M.121.

b) *Setting-up the multiple-destination international sound-programme circuit*

This will be checked in accordance with Recommendation N.12. The " send reference " station (R′ in Figure 2/N.30) will coordinate the work in conjunction with the receive-end control stations. In the case of difficulty the " send reference " station (R in Figure 2/N.30) will be called in to check the international circuit section.



= audio equipment proper to the circuit section

× = audio equipment associated with switching

I.S.P.C. = international sound-programme centre

R = " send reference " station for the multiple-destination international sound-programme circuit section

R′ = " send reference " station for the multiple-destination international sound-programme circuit

FIGURE 2/N.30. — **Multiple-destination international sound-programme circuit routed via a communication satellite.**

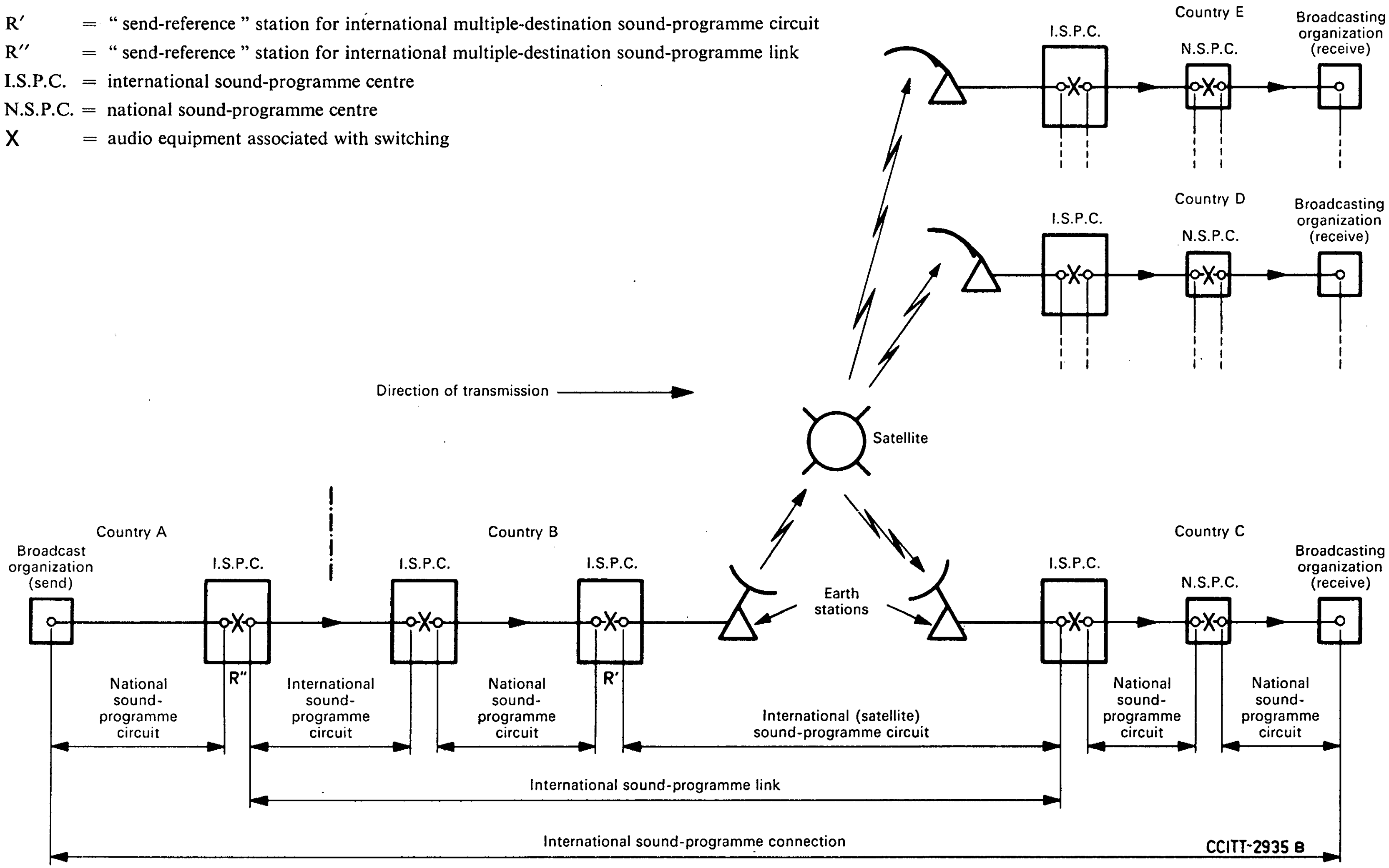


FIGURE 3/N.30. — **Multiple-destination international sound-programme link extended to form a connection routed via a communication satellite.**

1.5 — Automatic measuring equipment for sound-programme circuits

Recommendation O.31

SPECIFICATION FOR AN AUTOMATIC MEASURING EQUIPMENT FOR SOUND-PROGRAMME CIRCUITS

1. *General*

The C.C.I.T.T. automatic measuring equipment for sound-programme circuits is capable of rapidly measuring all relevant parameters necessary for checking the quality of such circuits. The measuring results are recorded by means of an analogue recorder and/or digital receiver. The results of the measurements are suitable for subsequent documentation and not only permit an immediate decision by the staff in the field on whether the sound-programme circuit or sound-programme connection respectively can be used for service, but they also provide the basis for later exact evaluation by the responsible transmission engineer.

The overall time for the measurements amounts to 133 seconds. It is thus short enough to check the quality also of international chains of sound-programme circuits interconnected on a short-term basis during the preparatory and lining-up period according to Recommendation N.4. Measurements for this purpose, made by the I.S.P.C.s involved in accordance with Recommendation N.12 and N.13, do not require any preceding agreement.

2. *Quality criteria to be checked*

With the C.C.I.T.T. automatic measuring equipment for sound-programme circuits the following quality criteria can be checked:

a) deviation of the received absolute power level of the 0.8 kHz lining up tone from the nominal value;

b) weighted and unweighted noise power;

c) non-linear distortion measured selectively as harmonic distortion of the 2nd and 3rd order and as a difference tone distortion of the 3rd order;

d) compandor functioning test;

e) loss frequency distortion.

The complete measuring programme, which is preceded by a station coding of the sending units, comprises three sub-routines. The quality criteria to be checked are allotted to the sub-routines in the following way:

Sub-routine 1: s + a

Sub-routine 2: b + c + d

Sub-routine 3: e

Within the sub-routine the timing of the programme in the sending unit and in the receiving unit is synchronized by means of a series of pulses provided by a generator within the equipment.

3. *Specifications*

3.1 *Sending unit*

3.1.1 *Start, stop and time base for synchronization and selection of measuring mode*

By means of a locking press-button in the sending unit the measuring programme for single or permanent mode of operation can be started. The timing of the measuring programme is controlled by a pulse generator. The smallest time base that can be programmed is fixed at 1.33 second. The synchronizing frequency related to this time base gives 0.75 Hz and has to be kept within $\pm 1\%$. A second press-button offers the possibility of stopping the measuring programme. By the activation of this press-button a means is provided whereby the locking mechanism of the start press-button for permanent operation is simultaneously released. Start, synchronization and stop of the receiving unit are triggered by coded pulses (1.3 kHz at −12 dBm0).

Every sub-routine is preceded by such a coded pulse which serves as a start signal. By means of a special stop signal which is triggered by pressing the stop button, the emission of the running measuring programme can be interrupted at any time and another programme selected with the aid of a switch can be started instead. By using the stop button the time pulse generator is reset to the starting condition.

The coded pulse consists of four pulses whose duration can be fixed at 60 ms (value O) or 120 ms value L) by means of digital coding. The distance between the beginning of every pulse within the coded pulse is 240 ms.

The coding of the pulses is as follows:

Start signals for:

Sub-routine 1: OOOL

Sub-routine 2: OOLO

Sub-routine 3: OLOO

Stop signal: LLLL

The emission of the coded pulse (duration 960 ms) which is controlled by the time pulse generator must be delayed 370 ms.

3.1.2 *Station coding*

The measuring programme is preceded by the code of the sending station using the Morse alphabet. For this end 19 timing pulses are provided which may be filled either by pulses, bars or intervals. According to the rhythm of a particular code a 0.8 kHz tone of −32 dBm0 is changed to the absolute power level for lining-up. The duration of Morse dots and dashes shall be 25% or 50% respectively, of one timing pulse.

3.1.3 *Absolute power level sent for lining-up measurements and for measurements at " all " frequencies*

According to Recommendation N.21 the absolute power level sent for the lining-up measurements (0.8 kHz) and for the measurements at " all " frequencies should be as low as −12 dBm0. The measurements at " all " frequencies are to be carried out with the aid of a sweep generator comprising the frequency range from 0.03 ... 16 kHz. Each octave—beginning at 0.05 kHz— is marked by short pulses (1.3 kHz/ −12 dBm0/50 ... 100 ms). The speed of this sequence of operations for the frequency range from 30 ... 16 000 Hz which covers 9.06 octaves should be 5 seconds/octave so that the recording device dealt with in item 3.2.5 records one octave over 10 mm.

3.1.4 *Absolute power level sent for non-linear distortion measurements* [1]

The sent absolute power level at the test frequencies corresponds to the peak programme level (see note to Recommendation N.13), that is, the single tones for the non-linear distortion measurements lead to the same peak loading as the double tone for the difference tone factor measurements (single tone $2.2\ V_{\mathrm{r.m.s.}} = 3.1\ V_{\mathrm{po}}$ and double tone $2 \times 1.1\ V_{\mathrm{r.m.s.}} = 2 \times 1.55\ V_{\mathrm{po}} = 3.1\ V_{\mathrm{po}}$ referred to a zero relative

[1] It shall be possible for the signal sent for the measurement of non-linearity distortion to be included in or omitted from the test cycle at will (for example, under control of a switch). Whether or not the non-linearity distortion measurement is admissible must be determined for each circuit by users of the device, and in a manner ensuring that the prescriptions of Recommendation N.21 are respected.

level point). In order to avoid overload of carrier frequency transmission systems only frequencies below 2 kHz (with regard to circuits equipped with pre- and de- emphasis techniques) are applied and the duration of transmission is automatically reduced to the length of a single timing pulse [1]. The following test frequencies should be used:

a) For the measurement of non-linear distortion in the lower audio-frequency range:

$$\left.\begin{array}{l}\text{0.09 kHz for the } k_2\text{—measurement}\\ \text{0.06 kHz for the } k_3\text{—measurement}\end{array}\right\}\text{ using a 0.18 kHz filter}$$

b) For the measurement of non-linear distortion in the medium audio-frequency range:

$$\left.\begin{array}{l}\text{0.8 kHz for the } k_2\text{—measurement}\\ \text{0.533 kHz for the } k_3\text{—measurement}\end{array}\right\}\text{ using a 1.6 kHz filter}$$

c) For the measurement of non-linear distortion in the carrier-frequency range of a frequency-division multiplex-channel:

0.8 kHz + 1.42 kHz for the d_3—measurement using a 0.18 kHz filter =
2 × 0.8 kHz − 1.42 kHz

The measurement of the upper d_3—modulation product at 2.04 kHz (=2 × 1.42 kHz − 0.8 kHz) is not made. To compensate for this, two times the lower d_3—product at 0.18 kHz is taken.

3.1.5 *Sending signal for compandor functioning test* [2]

In order to detect rapidly a non-complementary behaviour of regulating amplifiers in compandors a 0.8 kHz signal is injected, the absolute power level of which is switched between the values +6, −6, +6 dBm0 for the three respective timing pulses.

3.1.6 *Remote control of the sending unit*

Provision should be made for sending up to 16 switching functions. These signals may be applied to the sending equipment in either binary code or by applying earth to 16 signal paths.

3.2 *Receiving unit*

3.2.1 *Start, stop and synchronization*

In the receiving unit the coded pulses must be separated by means of a selective process. This requires a reduction of the sound sensitivity which can be achieved by a protective circuit similar to the one normally used for the signal receivers used in telephone engineering. Following the rectification, the control signals for the receiving unit are to be derived from the coded pulse with the aid of commercially available integrated circuits. In combination with the above-mentioned selective protective circuit the 4-bit code chosen offers a highly reliable protection against the possibility that the starting mechanism might be activated by sound-programme signals. Thus, the receiving unit can remain continuously connected to a sound-programme circuit and can record the measuring programme without intervention by an operator.

The timing schedule must be in conformity with the requirements specified for the sending unit (see item 3.1.1).

The time pulse generator shall be triggered after the reception of the coded pulse of the start signal. Transmission of the stop signal shall cause the time pulse generator to be reset to the starting condition.

[1] Other methods are under study by the C.C.I.T.T.

[2] This test is intended for provisional use. A change will be necessary when after further study the C.C.I.T.T. issues recommendations for compandors and appropriate methods of their testing.

3.2.2 *Measurement of absolute power level and of noise power*

All measurements are expressed in terms of r.m.s. values. The dynamic properties of the rectifier circuitry for noise measurements should meet the requirements of Recommendation P.53 (Volume V of the *Green Book*). The weighting network for the noise power measurements should be in accordance with the specification given in the Annex to Recommendation J.16 of Volume III of the *Green Book*.

The measuring device should have a logarithmic characteristic, and a linear measuring range of ± 10 dB referred to the respective centre-of-range should be provided.

For the particular measuring function the following centres-of-range should be provided.

— lining-up tone and tones at all frequencies	−12 dBm0
— noise power weighted and unweighted	−51 dBm0
(signal/noise ratio referred to +9 dBm0	60 dB)
— non-linear distortion	−31 dBm0
(ratio referred to +9 dBm0	40 dB)
— level step signal	0 dBm0

3.2.3 *Additional markers provided at digital receivers*

Additional markers can be generated in the digital receiver as required by making use of the octave markers received from the sending unit as a timing base.

3.2.4 *Programming of digital receivers*

It shall be possible to programme the digital receiver so as to check that the circuits tested meet the required tolerances.

3.2.5 *Recording device*

The transient response time of the recording device should not exceed 200 ms.

Paper width and speed may be chosen according to national standards. The following values have proved to be practicable:

paper width 100 mm

paper speed 2 mm/s

The above mentioned values yield (on the 20-dB level range) a level scale of 2 dB/10 mm.

In addition to the recording device it would be desirable to provide appropriate access points for the use of an oscilloscope.

3.3 *Sequence of operations*

The sequence of operations of the measuring programme and the associated time units is shown in the Annex to this Recommendation.

3.4 *Long-term measurements of noise*

3.4.1 *Automatic long-term measurements of noise*

The receiver waits 10 time pulses after the previous cycle and then measures, without any start signal from the sender, long-term noise by a timer. In this period, 20 time pulses for unweighted noise and 60 time pulses for weighted noise should be provided at the same level-range-centre as given in 3.2.2 for noise, weighted and unweighted. Where an analogue receiver is used, a manually controlled switch should be provided, so that the level-range-centre of noise can be changed by a further ± 10 dB.

3.4.2 *Manual long-term measurements of noise*

Furthermore, in order to make measurements of weighted or unweighted noise continuously for unspecified long periods, it must be possible to make the timing mechanism inoperative.

3.5 *Matching characteristics*

According to the lining-up procedure for sound-programme circuits using the constant voltage method the following impedances are to be provided for:

— output impedance of the sending unit < 10 ohms

— input impedance of the receiving unit > 20 kohms

Both values may be changed by internal switching to 600 ohms if, for the lining up of the sound-programme circuit, the impedance matching method is applied following local practice. It should be possible to adjust the sending and receiving units by means of a switch to the following relative levels:

+6 dBr = nominal value at the repeater stations of Administrations;

0 dBr [1] = nominal value at the studios of broadcasting organizations.

3.6 *Accuracy of measurements*

Sending unit:

a) Individual generators

— level tolerance	±0.2 dB
— frequency tolerance	<1.0%
— harmonic distortion at $2f$ and $3f$	>0.1%

b) Sweep generator

— level tolerance at 0.8 kHz	±0.2 dB
— absolute power level/frequency response referred to 0.8 kHz	±0.2 dB

Receiving unit:

Tolerances, including recording device:

— mid-scale value −12 dBm0 and 0 dBm0	±0.3 dB
— mid-scale value −51 dBm0 and −31 dBm0	±1.0 dB

The required thermal stability must be obtained 15 minutes after switching on. As far as the details of the division of the tolerances are concerned, reference is made to the values given in Supplement No. 3.1 of this volume.

The tolerances may then be reduced by calibrating the sending and receiving units when interconnected on a loop basis.

[1] For certain purposes a level of −3 dBr or lower may be used.

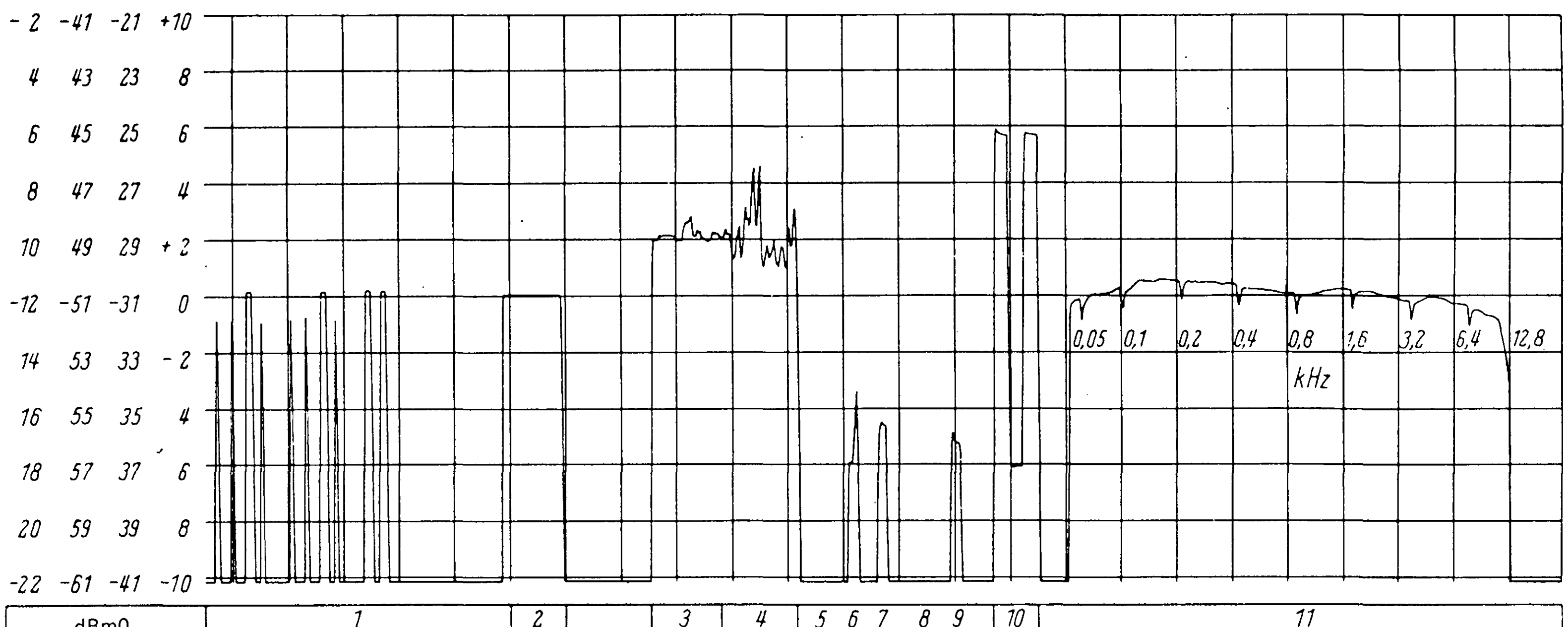
ANNEX
(to Recommendation O.31)

Sequence of operations

(See in the following appendix an example of the record of measurements made by a typical model of the automatic measuring equipment)

Time pulses	Sending unit		Receiving unit	
	Frequency kHz	Level dBm0	Measuring function	Centre of range dBm0
1	1.3	−12	Coded start signal No. 1	
1			Pause	
19	0.8 Morse	−32/−12 code	Station coding using Morse-alphabet	−12
1			Pause	
4	0.8	−12	Absolute power level sent for lining up	−12
2			Pause	
1	1.3	−12	Coded start signal No. 2	
2			Pause	
5			Noise power weighted by psophometer filter	−51
5			Noise power unweighted	−51
2			Pause	
1	0.09	+9	k_2-absolute power level with 0.18 kHz filter	−31
1			Pause	
1	0.06	+9	k_3-absolute power level with 0.18 kHz filter	−31
2			Pause	
1	0.8 1.42	+3 +3	d_3-absolute power level with 0.18 kHz filter	−31
2			Pause	
1	0.8	+9	k_2-absolute power level with 1.6 kHz filter	−31
1			Pause	
1	0.533	+9	k_3-absolute power level with 1.6 kHz filter	−31
2			Pause	
3	0.8	+6/−6/+6	Step-level signal	0
4			Pause with reserve	
1	1.3	−12	Coded start signal No. 3	
1			Pause	
35	0.03...16 with frequency marks at each octave beginning at 0.05 kHz	−12	Absolute power level/frequency response	−12
Total 100				

Example of the record of measurements made by a typical model of the automatic measuring equipment



dBm0 Scale				Measurement programme	Sending station	Receiving station	Circuit (Mono) (Stereo)	Length	Remarks
×				1 Station code					
×				2 0.8-kHz- Line-up					
	×			3 Noise weighted					
	×			4 Noise unweighted					
		×		5 non linear distortion at +9 dBm0 k_2 (0.09 kHz)					
		×		6 non linear distortion at +9 dBm0 k_3 (0.06 kHz)					
		×		7 non linear distortion at +9 dBm0 d_3 (0.8 + 1.42 kHz)	Date	Time			
		×		8 non linear distortion at +9 dBm0 k_2 (0.8 kHz)					
		×		9 non linear distortion at +9 dBm0 k_3 (0.533 kHz)					
			×	10 level steps +6/−6/+6 dBm0					
×				11 loss/frequency distortion					

CCITT 3425

APPENDIX to the Annex (to Recommendation O.31)

CHAPTER 3

TRANSMISSION

The Recommendations in sound-programme transmission have been arranged in three sections:

Section 1 General Recommendations concerning sound-programme transmissions.
(Recommendations J.11 to J.18)

Section 2 Performance characteristics of sound-programme circuits.
(Recommendations J.21, J.22 and J.23)

Section 3 Characteristics of equipment and lines used for setting-up sound-programme circuits.
(Recommendations J.31, J.32 and J.33)

SECTION 1

GENERAL RECOMMENDATIONS CONCERNING SOUND-PROGRAMME TRANSMISSIONS

Recommendation J.11 (Geneva, 1972)

THE HYPOTHETICAL REFERENCE CIRCUIT FOR SOUND-PROGRAMME TRANSMISSIONS

The C.C.I.T.T.,

considering the agreement reached in the C.M.T.T.,

unanimously recommends that

The detailed performance characteristics specified in the individual sound-programme circuit recommendations of Section 2 following are expected to be obtained over distances up to 2500 km, it being assumed that there are no more than two intermediate audio-frequency points [1].

It is convenient for design purposes to illustrate this concept by using a hypothetical reference circuit for sound-programme transmissions. The main features of the hypothetical reference circuit for sound-programme transmissions are shown in Figure 1/J.11, where the intermediate audio-frequency points M, M′ divide the total distance into three equal parts.

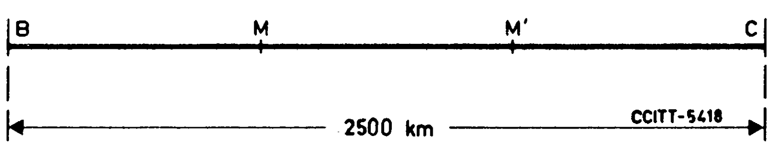


FIGURE 1/J.11. — **The hypothetical reference circuit for sound-programme transmissions**

It must not be thought that the hypothetical reference circuit (HRC) is identical to a sound-programme circuit, or an international sound-programme circuit as defined for maintenance purposes in Volume IV and (for convenience) illustrated in Figures 1/J.13 and 2/J.13, even though certain of these [2] display the same type of structure as the HRC. It must also be made clear that points B and C of Figure 1/J.11 do not correspond to a broadcasting studio or transmitter site which are connected by the local lines shown as A-B and C-D of Figure 2/J.11.

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[1] Clearly this restriction does not apply to circuits considered to be routed wholly on audio lines.

[2] Some examples of circuit arrangements which display the same structure as the HRC are: an international sound-programme connection comprising three international sound-programme circuits or a single sound-programme circuit made up of three sound-programme circuit sections.

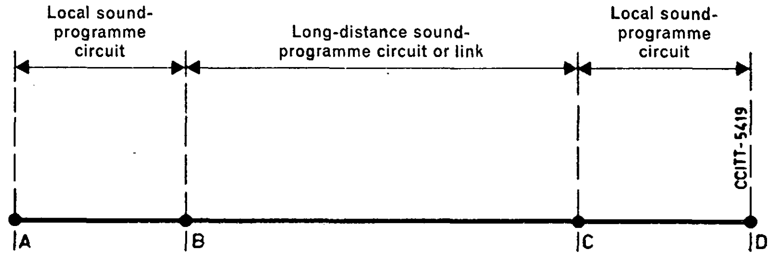

FIGURE 2/J.11. — **International sound-programme connection**

The purpose of the HRC is to enable standards of performance to be set for each type of sound-programme circuit recommended, and to allow the different types of sound-programme circuit to be compared on a common basis. The precise way in which the HRC is to be considered for each type of sound-programme circuit is given in the relevant Recommendation in Section 2.

For example, in order to arrive at the performance characteristics given in Recommendation J.22 the parts BM, MM', and M'C of the HRC would each be assumed to be a sound-programme circuit-section of the (10 kHz) type as defined in Recommendation J.22. Furthermore, for the purpose of designing equipment suitable for 10-kHz sound-programme circuits (Recommendation J.32), the individual sound-programme circuit sections could be assumed to all employ the same method of transmission, or could be assumed to employ different methods of transmission (e.g. carrier, audio, or PCM [1]).

Recommendation J.12 (formerly J.11 of the *White Book*; amended at Geneva, 1972)

TYPES OF SOUND-PROGRAMME CIRCUITS ESTABLISHED OVER THE INTERNATIONAL TELEPHONE NETWORK

The C.C.I.T.T. recognizes the types of sound-programme circuits defined below.

Note. — For the purposes of this Recommendation and other Recommendations in the J Series, sound-programme circuits have been classified in terms of the nominal effectively transmitted bandwidth. For convenience, the corresponding type of circuit from the administrative point of view (see Recommendation E.330, *Green Book*, Volume II-A) is given under each type of equipment in the following paragraphs.

1. *15-kHz type sound-programme circuit*

This type of circuit is recommended for high-quality monophonic programme transmission and in certain arrangements is also recommended for stereophonic transmissions. This type of circuit corresponds to the "very wideband circuit" or "stereophonic pair", as appropriate, referred to in Recommendation E.330.

The performance characteristics of 15-kHz type sound-programme circuits suitable for both monophonic and stereophonic transmissions are defined in Recommendation J.21 and suitable methods of provision are given in Recommendation J.31.

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[1] It would be premature at present to indicate any precise manner in which the HRC applies for PCM.

2. *10-kHz type sound-programme circuit*

This type of circuit, previously known as the "normal programme circuit, type A", is recommended for monophonic transmission only. Originally regarded as suitable for high-quality transmissions, it may continue to be used for many years to come to provide a good quality of sound-programme transmission. This type of circuit corresponds to the "wideband circuit" referred to in Recommendation E.330. The performance characteristics of 10-kHz type sound-programme circuits are defined in Recommendation J.22 and suitable methods of provision are given in Recommendation J.32.

3. *6.4-kHz type sound-programme circuit*

This type of circuit was previously known as "normal programme circuit, type B" and is now recommended where the saving of bandwidth is of great importance since this type of programme circuit when set up over carrier systems, displaces only two telephone channels. A 6.4-kHz type sound-programme circuit provides a lower standard of programme transmission than those given in 1 and 2 above but is adequate for many purposes. This type of circuit falls within the category of "medium-band circuits" referred to in Recommendation E.330.

The performance characteristics of 6.4-kHz type sound programme circuits are defined in Recommendation J.23, and methods or provision are given in Recommendation J.33.

Note 1. — A Question is under study (Question 3/XV) about the possibility of recommending a 5-kHz type sound-programme circuit, which would also fall within the category of "medium-band circuits" referred to in Recommendation E.330.

Note 2. — "Old-type programme circuits" are no longer the subject of C.C.I.T.T. Recommendations. Their general characteristics were described in former Recommendation J.41 and their methods of provision in former Recommendation J.42 (*White Book*, Volume III).

Note 3. — A technical recommendation on the use of telephone circuits for sound-programme transmission will be drawn up when there is an operating recommendation specifying the conditions under which such use is permissible [1].

Recommendation J.13 (formerly J.12, of the *White Book*; amended at Geneva, 1972)

DEFINITIONS AND RESPONSIBILITIES FOR INTERNATIONAL SOUND-PROGRAMME CIRCUITS

a) *Definition of the constituent parts of an international sound-programme connection*

The following definitions apply to international sound-programme transmissions.

1. *International sound-programme transmission*

The transmission of sound over the international telecommunication network for the purpose of interchanging sound-programme material between broadcasting organizations in different countries. Such a transmission includes all types of programme material normally transmitted by a sound broadcasting service, for example, speech, music, sound accompanying a television programme, etc.

2. *Broadcasting organization (send)*

The broadcasting organization at the sending end of the sound programme being transmitted over the international sound-programme connection.

[1] Text of Section 5 of Part III, Volume III, *White Book*.

3. *Broadcasting organization (receive)*

The broadcasting organization at the receiving end of the sound programme being transmitted over the international sound-programme connection.

4. *International sound programme centre (I.S.P.C.)*

A centre at which at least one international sound-programme circuit terminates and in which international sound-programme connections can be made by the interconnection of international and national sound-programme circuits.

The I.S.P.C. is responsible for setting up and maintaining international sound-programme links and for the supervision of the transmissions made on them.

5. *International sound-programme connection (Figure 2/J.13)*

The unidirectional path between the broadcasting organization (send) and the broadcasting organization (receive) comprising the international sound-programme link extended at its two ends over national sound-programme circuits to the broadcasting organizations.

6. *International sound-programme link (Figure 2/J.13)*

The unidirectional path for sound-programme transmissions between the I.S.P.C.s of the two terminal countries involved in an international sound-programme transmission. The international sound-programme link comprises one or more international sound-programme circuits interconnected at intermediate I.S.P.C.s. It can also include national sound-programme circuits in transit countries.

7. *International sound-programme circuit (Figure 1/J.13)*

The unidirectional transmission path between two I.S.P.C.s and comprising one or more sound-programme circuit sections (national or international), together with any necessary audio equipment (amplifiers, compandors, etc.).

8. *Sound-programme circuit-section (Figure 1/J.13)*

Part of an international sound-programme circuit between two stations at which the programme is transmitted at audio frequencies.

The normal method of providing a sound-programme circuit-section in the international network will be by the use of carrier sound-programme equipment. Exceptionally sound-programme circuit-sections will be provided by other means, for example, by using amplified unloaded or lightly loaded screened pair cables or by using the phantoms of symmetric pair carrier cables.

9. *National circuit*

The national circuit connects the I.S.P.C. to the broadcasting authority; this applies both at the sending and at the receiving end. A national circuit may also interconnect two I.S.P.C.s within the same country.

10. *International sound-programme connection*

The assembly of the "international sound-programme link" and the national circuits between the broadcasting organizations, constitutes the "international sound-programme connection". Figure 3/J.13 illustrates, by way of example, an international sound-programme connection as it might be encountered in practice.

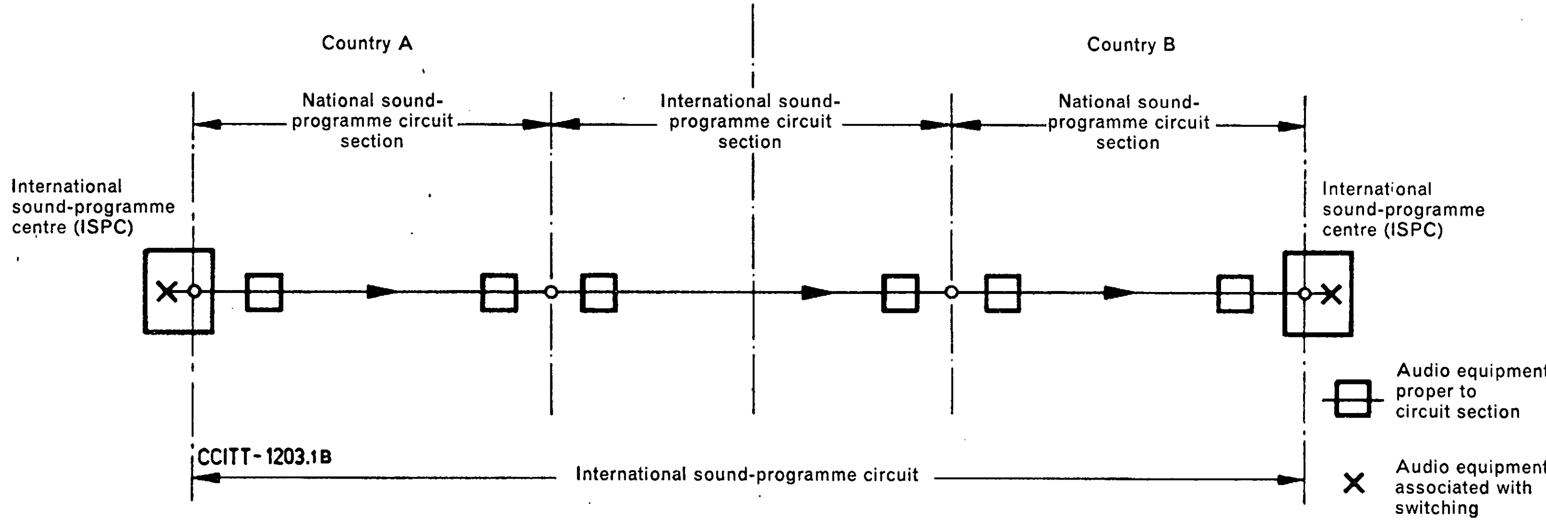


FIGURE 1/J.13. — **An international sound-programme circuit composed of two national and one international sound-programme circuit-section**

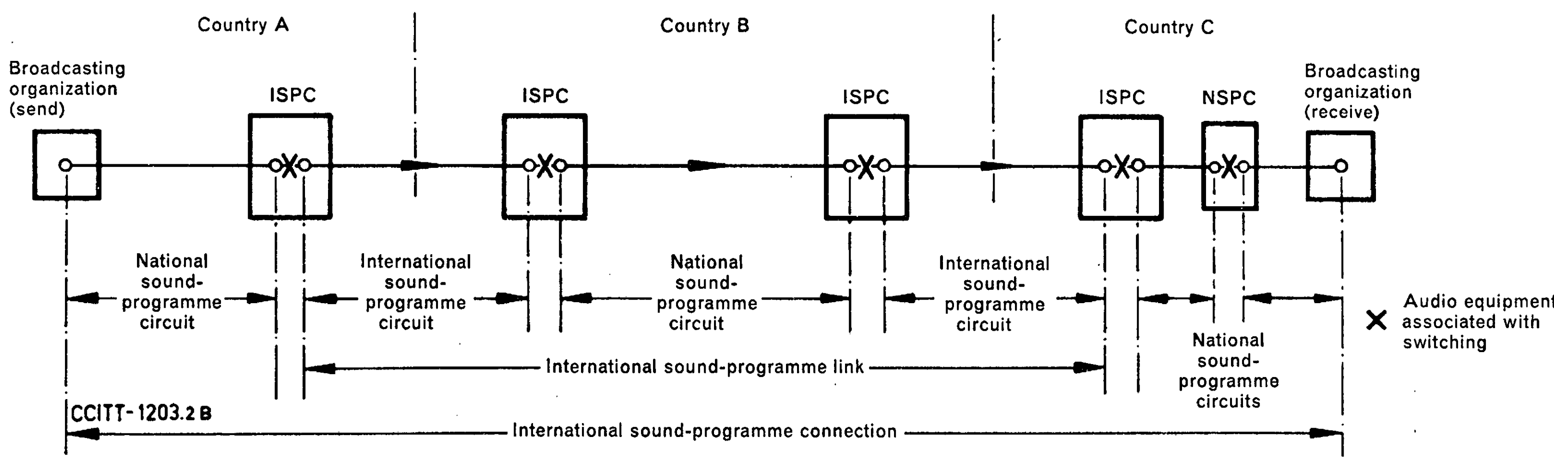
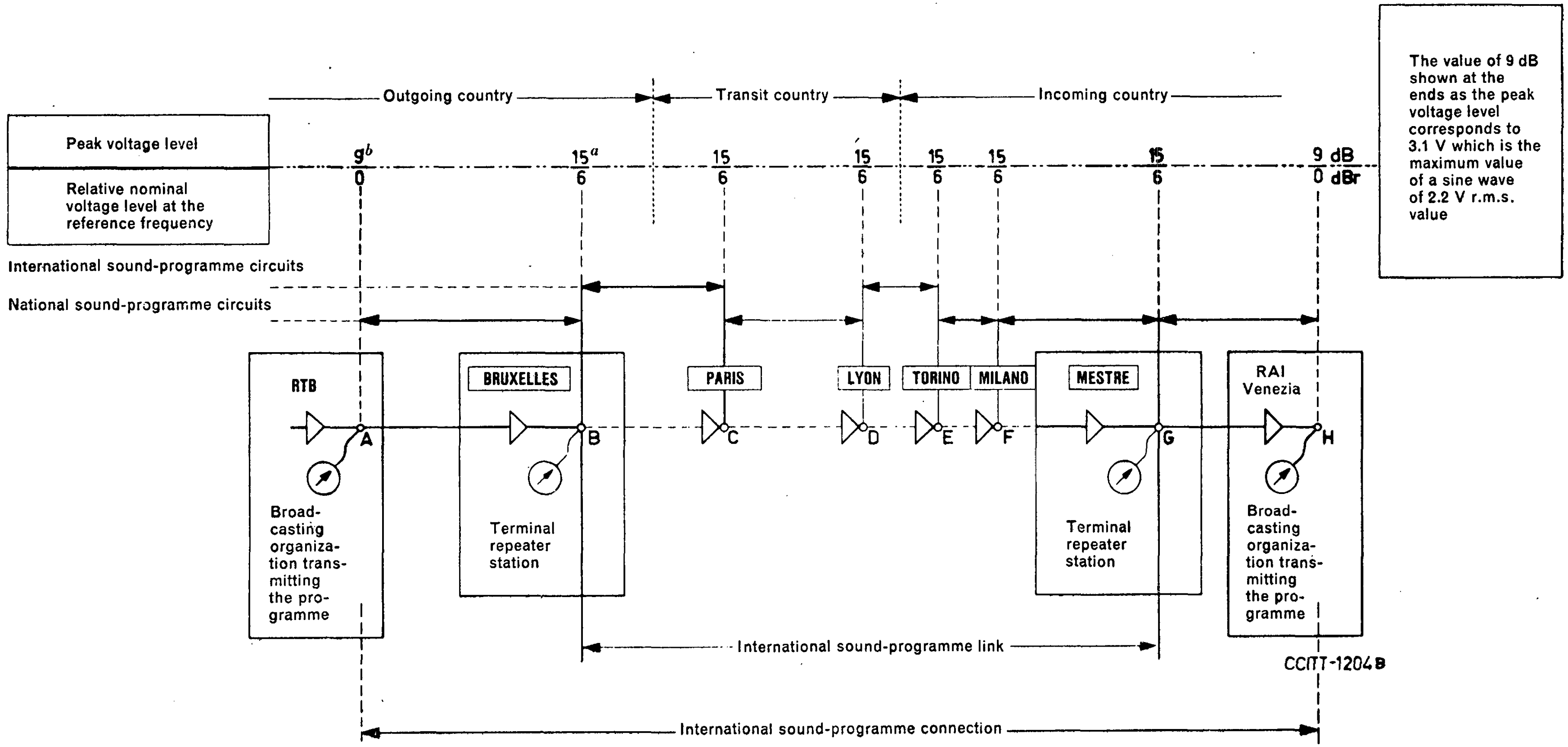


FIGURE 2/J.13. — **An international sound-programme link composed of international and national sound-programme circuits and extended on a national sound-programme circuit at each end to form an international sound-programme connection**



Volume meter or peak meter

Repeater station

[a] These levels are appropriate to national sound-programme circuits in the countries concerned.

[b] The RTB in fact adopts levels of 15/6 at this point.

FIGURE 3/J.13. — **Diagram of an international sound-programme connection in which all the countries concerned have chosen +6 dBr as the nominal relative level at points at which circuits are interconnected**

11. *Effectively transmitted signals in sound-programme transmission*

For sound-programme transmission a signal at a particular frequency is said to be effectively transmitted if the nominal overall loss at that frequency does not exceed the nominal overall loss at 800 Hz by more than 4.3 dB. This should not be confused with the analogous definition concerning telephony circuits given in Recommendation G.151, A, Note 1.

For sound-programme *circuits* the overall loss (relative to that at 800 Hz) defining effectively transmitted frequency is 1.4 dB, i.e. about one-third of the allowance.

12. *Origin and extremity of an international sound-programme circuit*

The "origin" of an international sound-programme circuit is considered as the output of the first amplifier and the "extremity" as the output of the last amplifier of the circuit. In the case of Figure 3/J.13, the direct circuit Bruxelles-Paris, for example, is comprised between the points B and C.

In the case of a circuit on a carrier system for programme transmissions, the origin of the circuit is the input of the modulating equipment and the extremity is the output of the demodulating equipment.

b) *Technical responsibilities during an international broadcast programme transmission*

The "international sound-programme link" is, in all cases, the sole responsibility of the telephone Administrations.

The extreme national circuits may be the responsibility of either the Administration, the broadcast organization or the two together depending on the local arrangements in each particular country.

Recommendation J.14 (formerly J.13, of the *White Book*; modified at Geneva, 1972)

RELATIVE LEVELS AND IMPEDANCES ON AN INTERNATIONAL SOUND-PROGRAMME CONNECTION

a) *Level adjustment on an international sound-programme connection*

The C.C.I.T.T. recommends the use of the "constant voltage" method. If, to a zero relative level point of the international sound-programme connection is applied a zero absolute voltage level (sine wave signal of 0.775 V r.m.s.) at one of the frequencies given in the Maintenance Instructions (Recommendation N.12, Volume IV, *Green Book*), the absolute voltage level at the output of the last amplifier of each sound-programme circuit (Points B, C, D ... G of Figure 3/J.13) should be +6 dB (i.e. 1.55 V r.m.s.) at 800 Hz, and should be within the given limits at other frequencies (see the appropriate Recommendations J.21, J.22, etc., for the limits applicable to the particular type of sound-programme circuit under consideration).

The zero relative level point is in principle the origin of the international sound-programme connection (Point A in Figure 3/J.13). Different conventions may be agreed between telephone Administration and broadcast organization within a country, provided that the levels on the international sound-programme link are unchanged.

b) *Diagram of signal levels on an international sound-programme connection*

The signal levels given below are expressed in terms of r.m.s. values of sine wave signals with reference to 0.775 V.

The voltage level diagram for an international sound-programme connection, however made up, should be such that the voltage levels shown are not such as to exceed the maximum undistorted power which an amplifier can deliver to a sound-programme link when peak voltage (i.e. +9 dB, reference 0.775 V) is applied to a zero relative level point on the international sound-programme connection.

With these conditions, +6 dB (reference 0.775 V) is the nominal voltage level at the output of the terminal amplifiers of the sound-programme circuits making up the international sound-programme link (Points B, C, D ... G of Figure 3/J.13).

The line amplifiers of the international sound-programme link should be capable of handling an upper voltage limit of at least +17 dB (reference 0.775 V), given the recommendation to use a constant voltage method for lining-up.

From the statement above that the voltage level at a zero relative level point can reach +9 dB (reference 0.775 V), the relative level obtained at the output of an amplifier would be $+17 - 9 = +8$ dB (reference 0.775 V). Assuming the maximum variation of this level with time to be ± 2 dB gives a nominal relative level at the output of these amplifiers of $+8 - 2 = +6$ dB (reference 0.775 V).

If a sound-programme circuit which is part of the international sound-programme link is set up on a group in a carrier system, the objective for a new design of equipment is that the relative level of the sound-programme circuit, with respect to the relative level of the telephone channel, should be chosen such that the mean value and the peak value of the load presented by the sound-programme channel should be no higher than that of the telephone channels which are replaced by the sound-programme channel. The effects of pre-emphasis and compandors should, where present, be taken into consideration.

It is recognized that this condition may not be observed in all cases, particularly in certain existing types of equipments. It is recommended that in those cases the zero relative level points of the sound-programme circuit and of the telephone channels should coincide.

It might be as well, however, if the equipment could, where possible, tolerate a maximum difference of ± 3 dB between the relative levels of the sound-programme and telephone transmissions, so that the best adjustment can be obtained, depending on any noise or intermodulation present, but at the same time observing the constraints imposed by the considerations on loading.

Recommendation J.15 (formerly J.14, of the *White Book*; amended at Geneva, 1972)

LINING-UP AND MONITORING AN INTERNATIONAL SOUND-PROGRAMME CONNECTION

To comply with the provisions of Recommendation J.14, the lining-up and monitoring of an international sound-programme connection should ensure that, during the programme transmission, the peak voltage at a zero relative level point will not exceed 3.1 volts, which is that of a sinusoidal signal having an r.m.s. value of 2.2 volts. The methods for achieving this condition as well as the relevant performance requirements are given in Recommendations N.10 to N.18 (*Green Book*, Volume IV).

Some indication of the volume or of the peaks of the signals during programme transmission may be obtained by monitoring at the studio, in the repeater stations, or at the transmitter. One of the instruments the characteristics of which are summarized in the table may be used.

PRINCIPAL CHARACTERISTICS OF THE VARIOUS INSTRUMENTS USED FOR MONITORING THE VOLUME OR PEAKS DURING TELEPHONE CONVERSATIONS OR SOUND-PROGRAMME TRANSMISSIONS

Type of instrument	Rectifier characteristic (Note 4)	Time to reach 99% of final reading (ms)	Integration time (ms) (Note 5)	Time to return to zero (value and definition)
(1) "Speech voltmeter" UK Post Office type 3 (S.V.3) identical to the speech power meter of the A.R.A.E.N.	2	230	100 (approx.)	equal to the integration time
(2) VU meter (United States of America) (Note 1)	1.0 to 1.4	300	165 (approx.)	equal to the integration time
(3) Speech power meter of the "S.F.E.R.T. volume indicator"	2	around 400 to 650	200	equal to the integration time
(4) Peak indicator for programme transmissions used by the British Broadcasting Corporation (B.B.C. Peak Programme Meter) (Note 2)	1		10 (Note 6)	3 seconds for the pointer to fall 26 dB
(5) Maximum amplitude indicator used by the Federal Republic of Germany (type U 21)	1	around 80	5 (approx.)	1 or 2 seconds from 100% to 10% of the reading in the steady state
(6) OIRT — Programme level meter: Type A sound meter Type B sound meter		for both types: less than 300 ms for meters with pointer indication and less than 150 ms for meters with light indication	 10 ± 5 60 ± 10	for both types: 1.5 to 2 seconds from the 0 dB point situated at 30% of the length of the operational section of the scale

Notes to the table

Note 1. — In France a meter similar to the one defined in line (2) of the table has been standardized.

Note 2. — In the Netherlands a meter (type N.R.U.-ON301) similar to the one defined in line (4) of the table has been standardized.

Note 3. — In Italy a programme meter with the following characteristics is in use:

Rectifier characteristic: 1 (see note 4)
Time to reach 99% of final reading: approx. 20 ms
Integration time: approx. 1.5 ms
Time to return to zero: approx. 1.5 s from 100% to 10% of the reading in the steady state.

Note 4. — The number given in the column is the index n in the formula $[V_{(\text{output})} = V_{(\text{input})}{}^{n}]$ applicable for each half-cycle.

Note 5. — The "integration time" was defined by the C.C.I.F. as the "minimum period during which a sinusoidal voltage should be applied to the instrument for the pointer to reach to within 0.2 neper (i.e. nearly 2 dB) of the deflection which would be obtained if the voltage were applied indefinitely". A logarithmic ratio of 2 dB corresponds to 79.5% and a ratio of 0.2 neper to 82%.

Note 6. — The figure of 4 ms that appeared in previous editions was actually the time taken to reach 80% of the final reading with a d.c. step applied to the rectifying integrating circuit. In a new and somewhat different design of this programme meter using transistors, the performance on programme remains substantially the same as that of earlier versions and so does the response to an arbitrary, quasi-d.c. test signal, but the integration time, as defined in Note 5, is about 20% greater at the higher meter readings.

Since there is no simple relation between the readings given by two different instruments for all types of programme transmitted, it is desirable that the broadcast organization controlling the studio and the telephone Administration(s) controlling the sound-programme circuit should use the same type of instrument so that their observations are made on a similar basis.

In general the telephone Administration and the broadcast organization of a country agree to use the same type of instrument. It is desirable to reduce to a minimum the number of different types of instrument and to discourage the introduction of new types which only differ in detail from those already in service.

During programme transmission the signal level at the output of the last amplifier controlled by the sending broadcast organization (Point A of Figure 3/J.13), should be monitored to see that the meter deflection of the measuring instrument is always lower than the peak voltage for the overall line-up, allowance being made for the peak factor of the programme involved.

It should be remembered that the amplitude range from a symphony orchestra is of the order of 60 to 70 dB, while the specification for sound-programme circuits is based on a range of about 40 dB. Before being passed to the sound-programme circuit, therefore, the dynamic ratio of the studio output needs to be compressed.

Recommendation J.16 (Geneva, 1972)

MEASUREMENT OF WEIGHTED NOISE IN SOUND-PROGRAMME CIRCUITS

The noise objectives for sound-programme circuits are defined in terms of psophometrically weighted noise power levels at a zero relative level point. Psophometric weighting is used to ensure that the objectives and the results of measurements are directly related to the disturbing effect of the noise to the human ear. The psophometric weighting for sound-programme circuits consists of two operations:

— a frequency-dependent weighting of the noise signal, and

— a weighting of the time function of the noise signal to take account of the disturbing effect of noise peaks.

To achieve results which are comparable, it is recommended that for the measurement of noise in sound-programme circuits a measuring set should be used which conforms to the characteristics laid down in Recommendation P.53, B.

Note. — The specification of a new measuring instrument and of the associated psophometric weighting curve is under study by C.M.T.T.

For information purposes the weighting frequency characteristic of such a measuring device is given in the following Annex.

ANNEX

(to Recommendation J.16)

Measurement of audio-frequency noise in broadcasting and in sound-recording systems

(C.C.I.R. Recommendation 468, with amendments proposed by C.M.T.T. in July 1972)

The C.C.I.R.

unanimously recommends

that for the measurement of audio-frequency noise in broadcasting and in sound-recording systems, to give results best in agreement with subjective assessment, a weighting network having a frequency response characteristic in accordance with Figure 1/J.16 should be used.

TABLE 1

FREQUENCY RESPONSE FOR THE CHARACTERISTICS SHOWN IN FIGURE 1/J.16

Frequency (Hz)	Response (dB)	Tolerances (dB)
31.5	−30.2	±2.0
63 100 200 400 800	−24 −20 −13.9 − 7.9 − 1.9	±1.0
1 000	0	±0.2
2 000 3 000 4 000 5 000	5.8 8.8 10.7 11.8	±0.5
6 300	12.3	0.0
7 100 8 000 9 000 10 000	12.0 11.2 10.0 8.1	±0.5
12 000	2.2	±1.0
14 000 16 000 20 000	− 5.5 −12.5 −22.2	±2.0
31 500	−35.7	±3.0

Note. — In order to obtain high accuracy the calibration is to be made at 6300 Hz as this frequency indicates the maximum of the curve and the most sensitive frequency range.

At 1000 Hz the sensitivity of the weighted and the unweighted measurement is equal, as it has been up to now, and therefore the small tolerance (±0.2 dB) had to be introduced for this frequency.

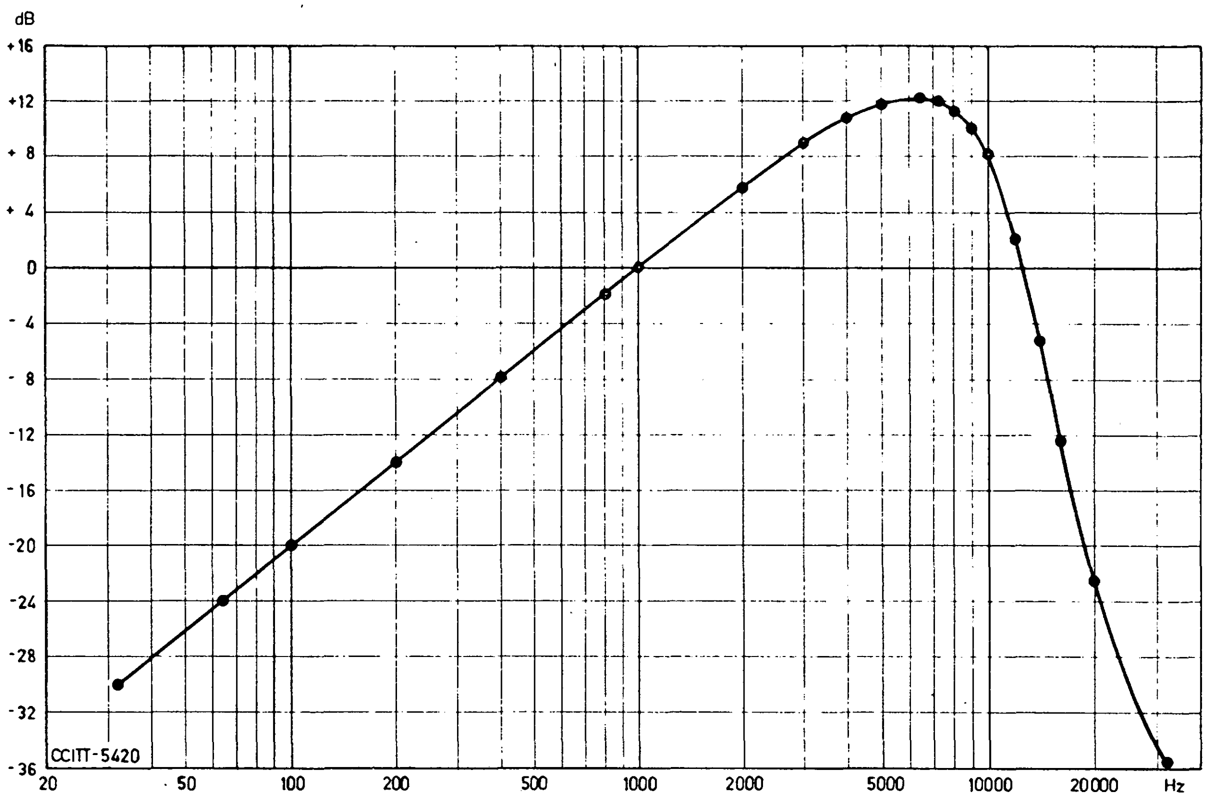


FIGURE 1/J.16. — **Frequency-response characteristics of the weighting network**

Recommendation J.17 (Geneva, 1972)

PRE-EMPHASIS USED ON SOUND-PROGRAMME CIRCUITS IN GROUP LINKS

The noise spectrum in group links is usually uniformly distributed, i.e. all parts of the frequency band are equally disturbed by the noise signal. Programme signals, on the other hand, are not of uniform distribution. The mean power density of the signal tends to decrease towards higher frequencies. Furthermore, the sensitivity of the receiving part (consisting of the radio receiver, the loudspeaker and the human ear) in respect of noise is very dependent on the frequency. (This can be seen from the psophometric weighting curve which is a measure of the sensitivity of the complete receiving part.)

Taking these three facts together it appears to be advantageous to use pre-emphasis on sound-programme circuits set up on carrier systems.

The advantages which could be gained by using different pre-emphasis curves are rather small. It is recommended, therefore, that a single pre-emphasis curve should be used whenever pre-emphasis is applied to sound-programme circuits in group links.

It is further recommended that the pre-emphasis attenuation curve should be that given by the following formula:

$$\text{insertion loss between nominal impedances} = 10 \log_{10} \frac{75 + \left(\frac{\omega}{3000}\right)^2}{1 + \left(\frac{\omega}{3000}\right)^2} \text{ (dB)}$$

where ω is the angular frequency corresponding to frequency f.

The de-emphasis network should have a complementary curve.

The pre-emphasis curve calculated from this formula passes through the following points:

f (kHz)	Insertion loss (dB)
0	18.75
0.05	18.70
0.2	18.06
0.4	16.48
0.8	13.10
2	6.98
4	3.10
6.4	1.49
8	1.01
10	0.68
∞	0

The measured pre-emphasis and de-emphasis curves should not depart by more than ± 0.25 dB from the theoretical curves when the measured levels at 800 Hz are made to coincide with the theoretical levels.

Note. — The formula given above defines only the "insertion-loss/frequency" characteristic. The level at which the modulated programme signal is given to the group link is different for the various types of sound-programme equipments and it depends on the modulation method and the type of compandors used. This information is given in the appropriate Recommendations (J.14, J.31).

Recommendation J.18 (Geneva, 1972)

CROSSTALK IN SOUND-PROGRAMME CIRCUITS SET UP ON CARRIER SYSTEMS

This Recommendation outlines the principles followed by the C.C.I.T.T. in determining what limits are appropriately set for sources of crosstalk affecting sound-programme circuits and other principles which Administrations might apply to ensure that the objectives for intelligible crosstalk in sound-programme circuits are achieved in practice.

1. The causes of crosstalk arising in the transmission parts of telecommunications networks occur in:
   a) frequency translating equipments at all levels, viz. audio, group, supergroup, and higher order translating equipments;
   b) group, supergroup, etc., through connection equipments (i.e. filter characteristics);

c) transmission systems, both the line (including repeater) and station equipments.

Different crosstalk mechanisms, e.g. inductive, capacitive and other couplings, intermodulation involving continuous fixed frequency tones such as pilots, etc., operate in these equipments and systems. A particular channel may thus be disturbed by intelligible crosstalk from a number of potential disturbing sources.

However, because of the interconnections which occur at flexibility points along the length of a sound-programme circuit the same disturbing and disturbed signals are rarely involved in more than one exposure.

2. Only the more important crosstalk mechanisms are the subject of C.C.I.T.T. Recommendations (e.g. coaxial and balanced pair cable repeater section FEXT limits, C.C.I.T.T. *Green Book* III, Section 3); the limits are such that at least the objectives for intelligible crosstalk ratio between *telephone* circuits (58 dB, Recommendation G.151) may be met. In some cases it is practicable to take into account the more stringent objectives for *sound-programme* circuits (Recommendations J.21, J.22 and J.23). Certain crosstalk mechanisms, because they are not significant for telephony (e.g. near-end crosstalk limits for cable repeater sections), are not the subject of C.C.I.T.T. Recommendations; nevertheless, they may be significant in relation to sound-programme circuit objectives.

In principle, a probability of exposure can be attributed to each source of crosstalk, not all potential sources exerting their influence in every case. Given the respective probabilities and distributions, the risk of encountering low values of crosstalk attenuation could be calculated.

Without carrying out this analysis it is estimated that the risk of encountering adverse systematic addition for some sources is small and the allocation of the complete overall objective to a single source of crosstalk as the minimum value of crosstalk attenuation appears justifiable. For other sources, particularly where the equipments involved are specifically intended for sound-programme transmission, it is appropriate to require some higher minimum attenuation values so as to allow for some adverse addition (Recommendation G.242 specifying through-connection filter discrimination requirements against out-of-band components in the band occupied by sound-programme circuits is an example).

3. For these reasons meeting intelligible crosstalk objectives on sound-programme circuits in practice depends on:

a) reasonable care in the allocation of plant for sound-programme circuits, so that the principal crosstalk mechanisms, a single exposure to any of which may itself suffice to exceed the objective, are avoided.

   Among these mechanisms are:

   - far-end and near-end crosstalk at certain frequency bands in line repeater sections (e.g. the lowest and highest frequency bands of coaxial systems);
   - systematic addition of near-end crosstalk between go and return channels of a group link;

b) readiness to change allocated plant in the few cases where crosstalk is excessive because of systematic addition of two or more disturbing sources.

4. The C.C.I.T.T. limits agreed for crosstalk ratios between bands potentially occupied by sound-programme circuits are in terms of effects at single frequencies. The following factors need to be taken into account when assessing from such limits the probability of encountering intelligible crosstalk into real sound-programme circuits:

a) no method of assessing the subjective effects of intelligible crosstalk in the bands occupied by sound-programme circuits have as yet been standardized;

b) the intelligibility of crosstalk can be affected by:

   — the use of emphasis in the disturbed circuit;

   — noise masking effects;

   — modulation arrangements (e.g. double sideband) in the disturbed circuit;

   — frequency offsets and inversions;

   — the use of compandors;

c) the mechanisms most liable to cause excessive intelligible crosstalk are, in general, highly frequency-dependent. These cases are those readily prevented by selective plant allocation advocated in 3 above;

d) crosstalk attenuation can, as a rule, be characterized by a mean value and a standard deviation; the mean value is usually several decibels higher than the worst value, which occurs with only a very small probability.

5. *Go-return crosstalk*

Here below are the assumptions made in the course of the C.C.I.T.T. study of go-return crosstalk in sound-programme circuits, and which served as the basis for the crosstalk limits prescribed in respect of group and higher-order translation equipments (Recommendation G.233, l).

a) the nominal maximum distance of the exposure to go-return crosstalk of two sound-programme circuits occupying opposite directions of the same group link is 560 km, i.e. 2/9 of the hypothetical reference circuit distance;

b) the equipments assumed to contribute to such go-return crosstalk are:

   — 560 km of line;

   — one pair of channel translations;

   — one pair of group translations;

   — three pairs of higher order translations;

   — two through connections.

The corresponding calculation is given in the Annex.

It was considered that the contribution of the line to go-return crosstalk can be limited to the range of values indicated in the Annex, given that precautions outlined in 3 above are exercised.

It is possible that, in the study of new transmission systems, the C.C.I.T.T. will be able to take such account of sound-programme circuit crosstalk objectives that these precautions may be relaxed somewhat. This study is in progress in the C.C.I.T.T. with respect to 60 MHz systems (Question 16/XV).

ANNEX
(to Recommendation J.18)

Calculations of overall go-return crosstalk between two sound-programme circuits occupying opposite directions of the same group link

Equipment	Crosstalk ratio limit (dB)	Crosstalk power per exposure in the disturbed circuit arising from a signal of 0 dBm0 on the disturbing circuit (pW)	Number of exposures	Total crosstalk power (pW)	Crosstalk ratio (dB)
Line	80-85 (single homogeneous) section)	10-3	2 (2/9 h.r.c.)	20-6	77-82
Channel translation	85	3	2	6	82
Group translation	80	10	2	20	77
Supergroup and higher translations	85	3	6	18	77.5
Through filters (cabling)	85	3	2	6	82
Totals (without compandors)				70-56	71.5-72.5
Totals (with programme-circuit compandors with a minimum advantage of 10 dB).				7-6	81.5-82.5

SECTION 2

PERFORMANCE CHARACTERISTICS OF SOUND-PROGRAMME CIRCUITS

Recommendation J.21 (Geneva, 1972)

PERFORMANCE CHARACTERISTICS OF 15-kHz TYPE SOUND-PROGRAMME CIRCUITS

(Circuits for high quality monophonic and stereophonic sound-programme transmissions)

The C.C.I.T.T., considering the agreement reached in the C.M.T.T.,

unanimously recommends

that, taking account of the definition in paragraph 1, high-quality monophonic and stereophonic sound-programme transmissions should satisfy the requirements laid down in paragraphs 2 and 3.

1. *Definition*

When the hypothetical reference circuit defined in Recommendation J.11 is composed of three "sound-programme carrier sections" the requirements indicated below should be met.

2. *Requirements at audio interconnection points*

2.1 *Measurement of characteristics*

When measuring the characteristics of a circuit, the output port should be loaded with 600 ohms non-reactive.

2.2 *Impedance and matching conditions*

The audio input impedance should be 600 ohms balanced, the tolerance on this value is the subject for further study.

It is provisionally recommended that the output impedance be balanced with respect to earth and be so low that the output level in the nominal transmission range does not decrease by more than 0.3 dB if the open-circuit output is loaded with 600 ohms. This output impedance is intended for connection to a nominal load impedance of 600 ohms.

For amplifiers which are intended for direct connection to audio sound-programme lines, the reactive part of the output impedance should be restricted. A maximum value of 100 ohms for the series reactance part of the output impedance at frequencies in the transmitted range is provisionally recommended.

2.3 *Relative level*

The relative level on a sound-programme circuit at the audio-frequency amplifier output should be fixed at +6 dBr.

3. *Performance of the hypothetical reference circuit for 15-kHz type sound-programme circuits*

The values given correspond to circuits operating with analogue techniques and are expected to be met on such transmission systems. Special additional parameters concerning digital techniques are under study (see paragraph 4 below).

3.1 *Parameters for monophonic programme transmission*

3.1.1 Nominal bandwidth: 0.04 to 15 kHz

3.1.2 Insertion gain at 0.8 or 1 kHz: This parameter should be measured at a sending level equivalent to −12 dBm0 as specified by the C.C.I.T.T. for setting up sound-programme circuits.

3.1.2.1 Adjustment error: not outside the range ± 0.5 dB

3.1.2.2 Daily variation: not outside the range ± 0.5 dB
If the broadcast organizations wish to have closer tolerances, it is necessary for the receiving broadcasting organizations to insert additional trimming attenuators.

3.1.3 The gain/frequency response referred to 0.8 or 1 kHz should comply with the limits indicated:

0.04 to 0.125 kHz:	+0.5 to −2.0 dB
0.125 to 10 kHz:	+0.5 to −0.5 dB
10 to 14 kHz:	+0.5 to −2.0 dB
14 to 15 kHz:	+0.5 to −3.0 dB

For the combined effect of three modulator and demodulator equipments, a tolerance of ± 0.5 dB from 0.125 to 10 kHz is considered the closest that can be met by equipments in practice. If broadcasting organizations wish to have closer tolerances, it is necessary for the receiving broadcasting organization to insert additional equalizers.

3.1.4 The difference between group delay at the given frequency and the minimum value group delay should not exceed the following limits [1]:

0.04 kHz:	55 ms
0.075 kHz:	24 ms
14 kHz:	8 ms
15 kHz:	12 ms

3.1.5 Maximum noise power level [1]:

3.1.5.1 Weighted noise:

— new network corresponding to C.C.I.R. Recommendation 468 [2] −47 dBm0;
— old network corresponding to C.C.I.T.T. Recommendation P.53 −51 dBm0;

[1] For both the weighted and unweighted noise figures, the C.M.T.T. thinks that it will be necessary in the future to also indicate limits measured with quasi-peak reading instruments in order to take into account the subjective effects of peaks in the noise-spectrum.

[2] See Annex to Recommendation J.16.

3.1.5.2. Unweighted noise: −41 dBm0.

The values given for both the weighted and unweighted noise should not be exceeded for more than 1% of any month. For 0.1% of any month, limits 8 dB higher seem to be acceptable.

3.1.6 The single-tone interference, measured selectively should not exceed (−73−Δps) dBm0 in which Δps is the correction for the frequency being measured in the (new) weighting characteristic in Table 1 of the Annex to Recommendation J.16.
In the case of sound-programme transmissions over carrier systems, carrier leaks may be expected. For this reason, stop filters may be provided in the carrier frequency path which can be switched in, if required, to suppress the tones, otherwise audible in the upper frequency range from 8 to 15 kHz. For an HRC, it is recommended that stop filters have a 3-dB bandwidth of less than 3% referred to the mid-frequency. The use of stop filters influencing frequencies below 8 kHz should be avoided.

3.1.7 Disturbing modulation by power supply:
The highest-level unwanted side-component due to modulation of a sound-programme signal caused by interference from power supply sources should not be greater than −45 dB relative to the level of a sine-wave measuring signal applied to the sound-programme circuit (conforming to C.C.I.R. Recommendation 474). The value for higher frequencies has to be determined.

3.1.8 Non-linear distortion

3.1.8.1 Harmonic distortion factors measured with single-tone test signals at +9 dBm0 should not exceed the following limits:

Frequency of test-tone	*Total harmonic distortion*	*Second harmonic and third harmonic measured selectively*
0.04 to 0.125 kHz	1%	0.7%
0.125 to 7.5 kHz	0.5%	0.35%

The duration for which a single-tone is to be transmitted at this level should be restricted in accordance with the appropriate C.C.I.T.T. Recommendations of the N series.

3.1.8.2 The difference tone[1] factors selectively measured with double-tone send signals each at +3 dBm0 should not exceed the following limits:

3.1.8.2.1 frequencies 0.8 and 1.42 kHz corresponding to those prescribed in Recommendation O.31 (*Green Book*, Volume IV) 3rd-order difference tone measured at 0.18 kHz: 0.5%

3.1.8.2.2 frequencies 5.6 and 7.2 kHz for a 2nd-order difference tone measured at 1.6 kHz: 0.5%

[1] Attention is drawn to the fact that in transmission systems using compandors, a 3rd order difference tone may occur which exceeds the specified limit of 0.5%. This may occur when the difference between the two fundamental frequencies is less than 200 Hz. Thus the components due to 3rd order distortion will have frequencies which correspond to the difference between the two test frequencies. However, in these cases the subjective masking is such that a distortion up to 2% is acceptable.

3.1.8.2.3 frequencies 4.2 and 6.8 kHz for a 3rd-order difference tone measured at 1.6 kHz: 0.5%

The measurements under 3.1.8.2.2 and 3.1.8.2.3 above are intended for baseband transmissions on physical circuits only and on modulation equipments in local loop.

3.1.8.3 Distortion products measured by weighted noise (being studied by C.M.T.T.)

3.1.9 Error in reconstituted frequency: not greater than 1 Hz

3.1.10 Intelligible crosstalk ratio: The intelligible crosstalk ratio from other sound-programme circuits or from a telephone circuit into a sound-programme circuit should be measured selectively in the disturbed circuit at the same [1] frequencies as that of the sinusoidal test signal applied to the disturbing circuit, and should not be less than the values determined by the following description of limits:

0.04 kHz	50 dB
0.04 to 0.5 kHz	oblique straight-line segment on linear-decibel and logarithmic-frequency scales.
0.5 to 5 kHz	74 dB
5 to 15 kHz	oblique straight-line segment on linear-decibel and logarithmic-frequency scales.
15 kHz	60 dB

3.1.11 Error in amplitude/amplitude response:
When the level of a 0.8 or 1 kHz test signal is changed from +6 to −6 dBm0, the level difference at the receiving end should not lie outside the range 12 ±0.5 dB.
This level change of the test signal corresponds to that prescribed in Recommendation O.31 (*Green Book*, Volume IV).

3.2 *Additional parameters for stereophonic programme transmission*

3.2.1 The difference in gain between A and B channels should not exceed the following values:

0.04 to 0.125 kHz:	1.5 dB
0.125 to 10 kHz:	0.8 dB
10 to 14 kHz:	1.5 dB
14 to 15 kHz:	3 dB

3.2.2 The phase difference between the A and B channels should not exceed the following values:

0.04 kHz	30°
0.04 to 0.2 kHz	oblique straight-line segment on linear-degree and logarithmic-frequency scales.
0.2 to 4 kHz	15°
4 to 14 kHz	oblique straight-line segment on linear-degree and logarithmic-frequency scales.
14 kHz	30°
15 kHz	40°

3.2.3 The crosstalk ratio between the A and B channels should not be less than the following limits:

3.2.3.1 Intelligible crosstalk ratio, measured with sinusoidal test signal
0.04 to 15 kHz: 50 dB;

3.2.3.2 Non-linear crosstalk ratio
0.04 to 15 kHz: 60 dB.

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[1] In cases where difficulties arise with this method another method will need to be used.

4. *Performance of the hypothetical reference circuit for 15-kHz type sound-programme circuits with particular reference to digital methods of transmission*

   (Being studied by the C.M.T.T.)

5. *Estimation of the performance of circuits shorter or longer than the HRC*

   (Being studied by the C.M.T.T.)

Recommendation J.22 (formerly J.21, of the *White Book*; amended at Geneva, 1972)

PERFORMANCE CHARACTERISTICS OF 10-kHz TYPE SOUND-PROGRAMME CIRCUITS

When the hypothetical reference circuit defined in Recommendation J.11 is assumed to be made up of three 10 kHz sound-programme circuit-sections the characteristics given in the following clauses of this Recommendation apply with the following reservations:

1. for an audio-frequency circuit, all the characteristics are valid except for intelligible crosstalk;
2. for a circuit on a carrier system, all the characteristics are valid, except for intelligible crosstalk and noise (see the Annex to this Recommendation and also Recommendation J.18).

a) *Band of frequencies effectively transmitted*

The band of frequencies effectively [1] transmitted by the complete link should extend at least from 50 to 10 000 Hz.

b) *Line levels* (see Recommendation J.14)

c) *Attenuation distortion*

Figure 1/J.22 shows the permissible limits for the variation with frequency (relative to the value measured at 800 Hz) of the relative voltage level (referred to 0.775 V) measured at the end of the circuit. The method of measuring this relative level is shown in Recommendation N.21 (Volume IV of the *Green Book*).

When the circuit is set up on a carrier system, the curve applies to the overall combination of three pairs of equipments for modulation from or demodulation to audio-frequencies, as included in the hypothetical reference circuit for sound-programme transmission.

d) *Phase distortion*

The index of the phase distortion (or difference between the group delay, t_f, at the frequency f considered and that at the frequency corresponding to the minimum group delay) should not exceed the following values:

$t_{10\,000} - t_{min}$: 8 ms
$t_{100} - t_{min}$: 20 ms
$t_{50} - t_{min}$: 80 ms

[1] See Recommendation J.13, Definition 11.

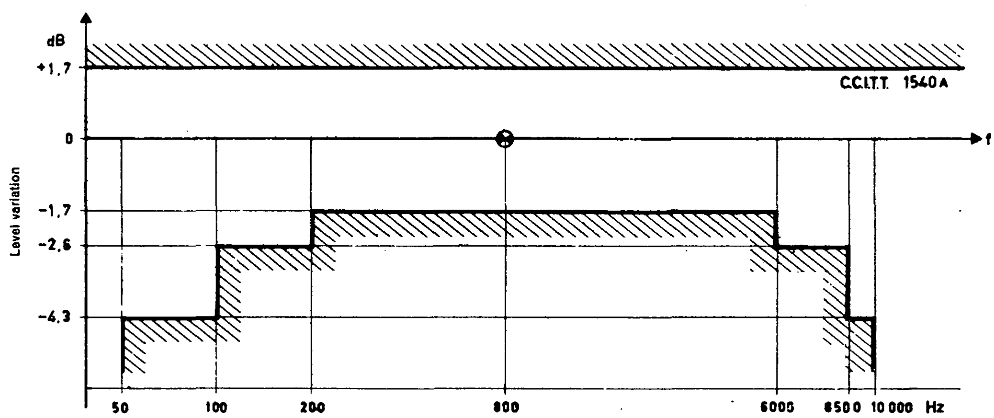

FIGURE 1/J.22. — **Variation with frequency of the relative voltage level at the end of a 10-kHz type sound-programme circuit. The values are shown relative to 800 Hz**

e) *Noise* [1]

1. *Psophometric voltage*

When the circuit is terminated at the far end by a non-reactive 600 ohm resistance, and when the input is terminated with a non-reactive resistance equal to the modulus of the nominal impedance of the first amplifier, then, when measured with the programme-circuit psophometer [2], the psophometric voltage at the far end of the circuit at a point where the nominal relative level is fixed at +6 dB should not be more than 6.2 mV for cable circuits or 15.6 mV for open-wire circuits.

Hence the ratio between the "maximum voltage" [3] and the psophometric voltage (circuit noise and crosstalk) is at least 710/1 (57 dB) for cable circuits, and at least 283/1 (49 dB) for open-wire circuits.

2. *Unweighted voltage*

The voltage due to noise, measured objectively without a weighting network, at the extremity of the circuit should not exceed 62 mV for cable circuits and 156 mV for open-wire lines. This measurement should cover the frequency band from 30 to 20 000 Hz; it is as well to make sure that there is no danger of overloading or parasitic modulation.

Note. — In fixing these values, the dynamic range of the programme material has been taken as 40 dB.

f) *Intelligible crosstalk* (Provisional limits)

1. The near-end or far-end crosstalk ratio (for speech) between two sound-programme circuits or between a telephone circuit (disturbing circuit) and a sound-programme circuit (disturbed circuit) should be at least 74 dB for cable circuits and at least 61 dB for open-wire lines.

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[1] In the case of circuits on carrier systems, it is not always possible, in the absence of special precautions, to meet the limits recommended in this paragraph (see the following Annex).

[2] The psophometer should be provided with a special filter network, having the characteristics given in Recommendation P.53, B (*Green Book*, Volume V).

[3] The "maximum voltage" at a point in a circuit is the r.m.s. voltage at this point when a sinusoidal wave of 2.2 volts r.m.s. is applied at a zero relative level point on the international circuit.

2. The near-end or far-end crosstalk ratio (for speech) between a sound-programme circuit (disturbing circuit) and a telephone circuit (disturbed circuit) should be at least 58 dB for cable circuits [1] and at least 47 dB for open-wire lines.

Note 1. — The C.C.I.T.T. draws the attention of Administrations to the fact that, for a 1000 km circuit, it is in some cases difficult to meet these limits, notably when using unscreened pairs or programme channels on carrier systems (see Recommendation J.18).

Note 2. — The C.C.I.T.T. draws the attention of Administrations to the fact that, because of crosstalk which may occur in terminal modulating and line equipment, special precautions may have to be taken to meet the above crosstalk limits between two sound-programme circuits, simultaneously occupying the go and return channels respectively of a carrier system (the most economical arrangement), because in these circumstances they occupy the same position in the line frequency band (see Recommendation J.18).

g) *Change of relative level with time*

The 800 Hz relative level considered at the far end of the circuit should meet the defined conditions for attenuation distortion, and also during a given programme transmission should not change from its nominal value by more than ± 2 dB.

Also, for sound-programme circuits on special pairs or on the phantom circuits of unloaded symmetric pairs, the 800 Hz relative level at the output of a frontier amplifier should not change from its nominal value by more than ± 1 dB during a given programme transmission.

h) *Non-linear distortion*

The total harmonic distortion coefficient for the 2500 km hypothetical reference circuit for programme transmissions should not exceed 4% (harmonic distortion attenuation 28 dB) at any frequency within the band to be transmitted, the measurement being made with a sinusoidal signal (fundamental frequency) connected to the origin of the circuit (where the nominal relative level is +6 dB) at +4.4 V r.m.s. (corresponding to a voltage level of +15 dB relative to 0.775 V) the total harmonic distortion coefficient (k) being calculated from the formula:

$$k = \sqrt{k_2^2 + k_3^2}$$

where k_2 is the 2nd order harmonic distortion coefficient and k_3 is the 3rd order harmonic distortion coefficient.

However, the following values should be considered as desirable design objectives for future developments:

3% (30 dB) at fundamental frequencies below 100 Hz;
2% (34 dB) at fundamental frequencies above 100 Hz [2].

Note. — Precautions should be taken in the measurement of harmonic distortion on circuits equipped with pre-emphasis networks. This question is being studied by the C.C.I.T.T.

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[1] See Question 9/XV.

[2] The European Broadcasting Union has stated that many of its members have expressed the opinion that for a circuit of 1500 km, acceptable limits for non-linear distortion would be 40 dB at fundamental frequencies above 100 Hz and 34 dB at fundamental frequencies of 100 Hz and below (measuring signal of +9 dB at a zero relative level point).

i) *Disturbing modulation by the power supply*

The highest-level unwanted side components due to modulation of a sound-programme signal caused by interfering signals from power supply sources should not exceed −45 dB relative to the level of a sine-wave measuring signal applied to the sound-programme circuit.

j) *Error in reconstituted frequency*

The difference between the initial and reconstituted frequencies should not exceed 2 Hz.

ANNEX
(to Recommendation J.22)

Values of noise expected in practice on 2500 km circuits

Estimated noise power levels

The table 1 shows the noise values arising when sound-programme circuits (using pre-emphasis and de-emphasis in accordance with Recommendation J.17) are set up in place of three telephone channels, each of which conforms to the general noise objectives given in Recommendation G.222. The assumptions made for the purpose of the noise calculations are shown at the end of this Annex.

TABLE 1

	One-minute mean value	
	for not more than 20% of a month	for not more than 0.1% of a month
Psophometric power (weighting for programme transmissions) . . .	−44.5 dBm0ps	−37.5 dBm0ps

Note. — The increased noise level shown as occurring for less than 0.1% of a month applies when the carrier circuit is established over a radio-relay system.

Use of compandors

Provided the compressor and the expander are of the same make, it is possible to obtain overall transmission characteristics as regards noise which conform to the C.C.I.T.T. recommendations for the 2500 km hypothetical reference circuit without introducing other factors that might impair transmission performance. The C.C.I.T.T. is now examining recommendations on the compressor and the expander, considered separately, in order to achieve the same result.

Assumptions and conventional terms

The expression dBm0ps is used to indicate noise power levels in a sound-programme circuit which are psophometrically weighted and measured in decibels relative to 1 mW at a point of zero relative level in that circuit. The C.C.I.T.T. practice is to quote noise level for sound-programme circuits relative to "peak programme" or "maximum voltage" which is defined as a voltage of 2.2 V r.m.s. (across an impedance of 600 ohms) at a point of zero relative level, i.e. 9 dB above telephone test level, and the signal-to-noise ratio objective of 57 dB is thus equivalent to a noise power level of −48 dBm0ps.

The value for not more than 20% of a month was calculated on the following assumptions:

Noise on one telephone channel (including the multiplexing equipment) according to Recommendation G.222, weighted for telephony	−50 dBm0p
Bandwidth correction	+5 dB
Suppression of weighting for telephony (in the case of a uniform-spectrum noise)	+2.5 dB
Improvement due to pre-emphasis (see Recommendation J.17)	−9 dB
Effect of the relative level shifted for example by −1.5 dB	+1.5 dB
Weighting for sound-programme transmissions	+5.5 dB
Total	−44.5 dBm0ps

The value for not more than 0.1% of a month was calculated on the basis of the noise variations to be expected on a radio-relay link used mainly for providing telephone circuits and conforming with Recommendation G.222.

Recommendation J.23 (formerly J.31, B of the *White Book*; amended at Geneva, 1972)

PERFORMANCE CHARACTERISTICS OF 6.4-kHz TYPE SOUND-PROGRAMME CIRCUITS

The C.C.I.T.T. recommends that:

When the hypothetical reference circuit defined in Recommendation J.11 is assumed to be made up of three 6.4-kHz type sound-programme circuit-sections, the characteristics given in the following clauses of this Recommendation apply with the following reservations:

1. For audio transmission methods, all the characteristics are valid except for intelligible crosstalk.

2. For carrier transmission methods, all the characteristics are valid except for the intelligible crosstalk and noise (see Recommendation J.18 and the Annex to Recommendation J.22).

a) *Band of frequencies effectively transmitted*

The band frequencies effectively [1] transmitted by the complete link should extend from 50 to 6400 Hz at least.

b) *Line levels* (see Recommendation J.14)

c) *Attenuation distortion*

Figure 1/J.23 shows the permissible limits for the variation, as a function of frequency (relative to the value measured at 800 Hz) of the relative voltage level (referred to 0.775 V) measured at the end of the circuit. The method of measuring this relative level is shown in Recommendation N.21 (*Green Book*, Volume IV).

This curve applies to the overall combination of three pairs of equipments for modulation from or demodulation to audio-frequencies, as included in the hypothetical reference circuit for sound-programme transmission.

[1] See Recommendation J.13, Definition 11.

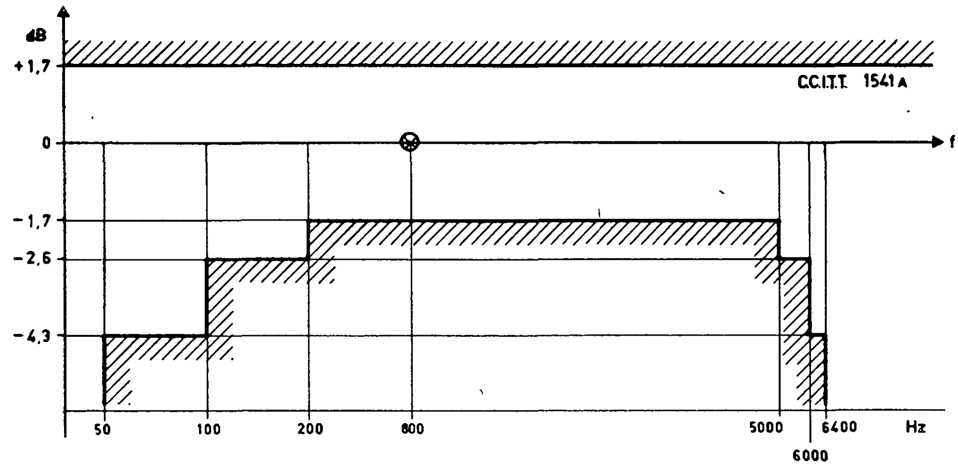


FIGURE 1/J.23. — **Variation, with frequency, of the relative voltage level at the end of a 6.4-kHz type sound-programme circuit. The values are shown relative to the value at 800 Hz**

d) *Phase distortion*

The index of the phase distortion (or difference between the group delay t, for the frequency f considered and for the frequency corresponding to the minimum group delay) should not exceed the values in the table below:

$t_{6400} - t_{min}$: 8 ms
$t_{100} - t_{min}$: 20 ms
$t_{50} - t_{min}$: 80 ms

e) *Noise*

The recommended limits are the same as for a 10-kHz type sound-programme circuit set up on three carrier channels (Recommendation J.22, e); the reservations in the Annex to that Recommendation also apply.

f) *Intelligible crosstalk*

The recommended limits are the same as for a 10-kHz type sound-programme circuit set up on three carrier channels (see Recommendations J.22, f, and J.18).

g) *Change of relative level with time*

The 800 Hz relative level considered at the far end of the circuit should meet the defined conditions for attenuation distortion and also, during a given programme transmission, should not change from its nominal value by more than ± 2 dB.

h) *Non-linear distortion*

The recommended values are the same as for a 10-kHz type sound-programme circuit set up on three carrier channels (Recommendation J.22, h).

SECTION 3

CHARACTERISTICS OF EQUIPMENT AND LINES USED FOR SETTING UP SOUND-PROGRAMME CIRCUITS

Recommendation J.31 (Geneva, 1972)

PERFORMANCE CHARACTERISTICS OF EQUIPMENT AND LINES USED FOR SETTING UP 15-kHz TYPE SOUND-PROGRAMME CIRCUITS

It is recognized that the overall objective given in Recommendation J.21 can be met by many different types of systems and that some solutions may be preferable to others for national networks, the choice depending on the particular requirements of an Administration.

It is, however, a basic objective of the C.C.I.T.T. to standardize a single solution to be adopted for international circuits. Furthermore, several Administrations have indicated that a single solution for international circuits will considerably ease the problem of providing these circuits.

The C.C.I.T.T. therefore recommends for international circuits the use of the solution described in Section A of this Recommendation, in the absence of any other arrangement between the interested Administrations, including if necessary the Administrations of the transit countries. Other solutions which have been considered and are capable of meeting the recommended characteristics of Recommendation J.21 are described in Annexes 1, 2 and 3.

Section B gives the characteristics of the group links which, in any case, have to be used.

A. Characteristics of an equipment allowing two 15-kHz type carrier-frequency sound-programme circuits to be established on a group

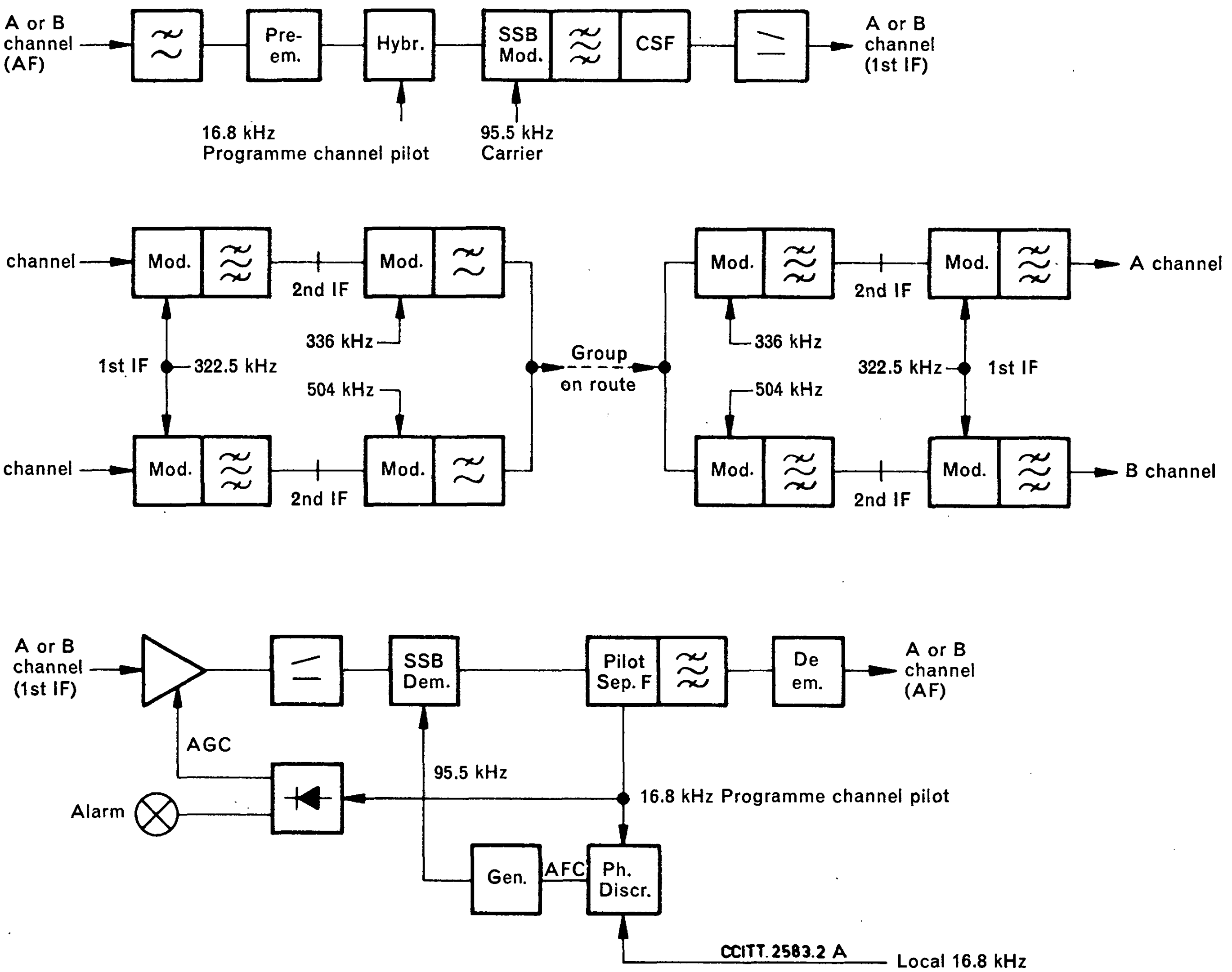
Introduction

This section defines an equipment allowing the establishment of 15-kHz type sound-programme circuits (in accordance with Recommendation J.21) on carrier telephone systems which conform to the noise objectives in Recommendation G.222. The use of this equipment does not cause either a mean or a peak load higher than that of the telephone channels which it replaces [1]. The two sound-programme circuits set up on one group can be used either as two independent monophonic circuits or as a pair of circuits for stereophonic transmissions.

[1] This is the objective given in Recommendation J.14 for new design of equipment.

The following paragraphs covering frequency position, pre-emphasis, compandor and programme channel pilot are to be considered as integral parts of the Recommendation, forming the complete definition of the equipment covered by this Recommendation.

The block schematic of a suitable equipment is given, by way of example, in Figure 1/J.31.



Pre-em.	= pre-emphasis	SSB dem.	= single side-band demodulator
Hybr.	= hybrid	Pilot Sep. F.	= pilot separating filter
Mod.	= modulator	De-em.	= de-emphasis
SSB mod.	= single side-band modulator	Ph. Discr.	= phase discriminator
CSF	= carrier separating filter	AFC	= automatic frequency control

FIGURE 1/J.31. — **First modulation, auxiliary modulations and demodulation of the two-channel programme system**

a) *Frequency position in the basic group 60-108 kHz*

The frequency position in the basic group is shown in Figure 2/J.31. For both programme channels, the tolerance on the virtual carrier frequency is ± 3 Hz and the programme channel pilot is fed in as 16 800 ± 0.1 Hz in the audio-frequency position.

Note. — Programme channel B can be replaced by telephone channels 1 to 6.

b) *Intermediate frequency position* (see 1st IF in Figure 3/J.31)

Both intermediate frequencies in Figure 3/J.31 are examples.

Inverted position, virtual carrier at the IF 95.5 kHz.

Interconnection at this intermediate frequency is possible; in the case of stereophonic sound-programme transmission each channel is individually connected. At the intermediate frequency point the sound-programme signal has been pre-emphasized and compressed.

The relative level at the interconnection point is similar to the relative level in the carrier telephone system in the basic group at the receiving end (−30.5 dBr). The absolute level is determined by pre-emphasis and compressor; the long-term mean power of the sound signal is about 250 μW0.

The nominal impedance chosen in this example is 150 ohms balanced with a 26 dB return loss.

The programme channel pilot is through-connected at 95.5 − 16.8 = 78.7 kHz, at a level of −12 dBm0 in the absence of a programme signal.

Special through-connection filters for the sound-programme channel are not required. The bandpass filters at the output of the second modulation stage (receiving end) have sufficient stop band rejection.

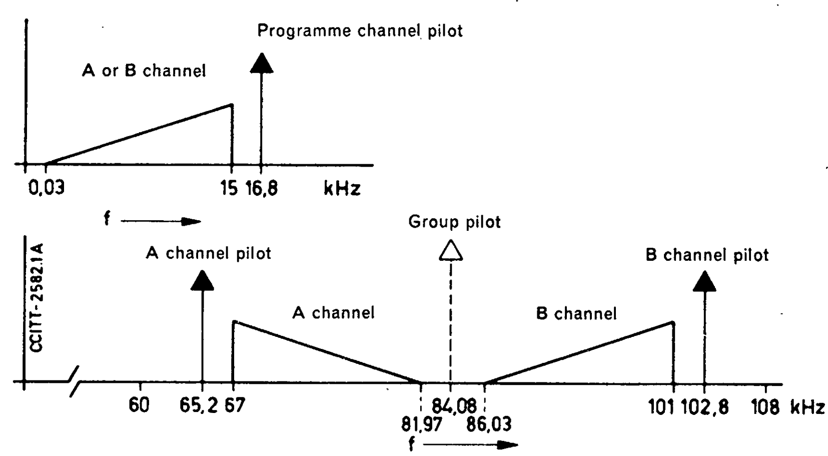


FIGURE 2/J.31. — **Line-frequency positions of the two-programme channels in the group**

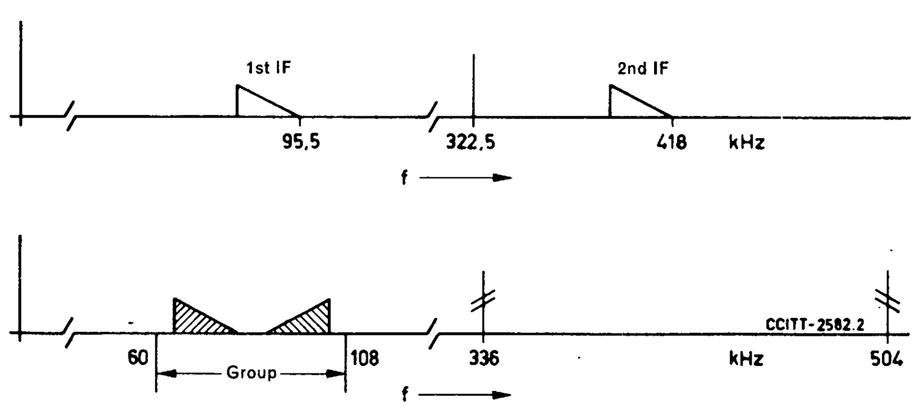


FIGURE 3/J.31. — **Modulation scheme for the two-channel programme system**

c) *Pre-emphasis and de-emphasis* should be applied before the compressor and after the expander respectively in accordance with Recommendation J.17, the 800 Hz attenuation of the pre-emphasis being set to 6.5 dB.

d) At the sending end *the 16.8 kHz pilot signal* is fed in after the pre-emphasis and before the modulator and the following compressor with a level of −29 dBm0 ± 0.1 dB. In the absence of a programme signal this pilot level is increased by 17 dB by the compressor to −12 dBm0(*t*) [1] on the carrier transmission path. After having passed through the expander, the pilot is branched off for control purposes after the demodulator and before the de-emphasis via a 16.8 kHz bandpass filter and is then suppressed in the transmission channel.

The control functions of the pilot are as follows: frequency and phase correction of the demodulator and compensation of the transmission loss deviations between compressor and expander. In view of the need to transmit stereophonic signals, the phase control should be sufficiently accurate so that the phase difference between the two channels does not exceed 1° even if the frequencies corresponding to the frequencies of the received pilots are falsified by ± 2 Hz due to the carrier system.

e) *Compandor*

1. As shown in Figure 4/J.31 the compressor characteristic has a transition from the range of constant gain at low input levels to a range of constant loss at high input levels. Table 1 indicates the precise dependence of the compressor amplification as a function of the input level. The compressor and expander are controlled by the r.m.s. value of the sum of the voltages of programme and pilot signals.

In Table 1, the compressor is pre-loaded by the pilot; in the absence of both programme and pilot, the gain of the compressor reaches the value of 22 dB.

The amplification of the expander is complementary to that of the compressor. The tolerance should also be ± 0.5 dB, or ± 0.1 dB as shown in Table 1.

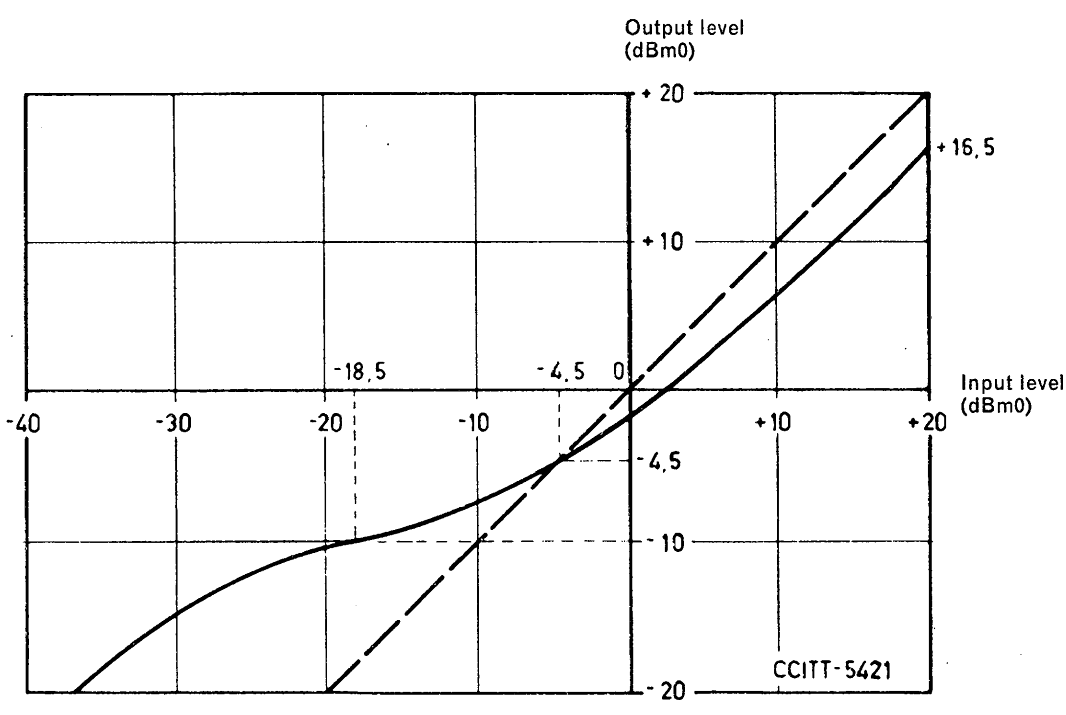


FIGURE 4/J.31. — Characteristic of the compressor

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1 dBm0(*t*) — denotes that the level quoted is referred to a relative level point in a telephone channel.

TABLE 1

COMPRESSOR CHARACTERISTIC

Programme signal level at the compressor input (dBm0)	Compressor gain (dB) (tolerance ±0.5 dB except at the points marked * where the tolerance is ±0.1 dB)
−∞	+17.0 *
−40.0	+16.9
−35.0	+16.5
−30.0	+15.6
−25.0	+13.2
−20.0	+ 9.7
−15.0	+ 6.0 *
−10.0	+ 2.7
− 5.0	+ 0.2
− 4.5	0.0
0.0	− 1.3
+ 3.0	− 2.0 *
+ 5.0	− 2.3
+10.0	− 2.9
+15.0	− 3.2
+20 0	− 3.5

2. The attack and recovery times of the compressor are measured in 12 dB steps (see Recommendations G.162 and O.31) between the point of the unaffected level of —4.5 dBm0 and the level of —16.5 dBm0 and vice versa. In order to obtain as pronounced an envelope as possible in the oscillogram, no pilot is used for the measurement, but a measuring frequency which is approximately in the middle of the intermediate frequency band and whose level is changed over. The attack and recovery times of the compressor are, as in Recommendation G.162, the times between the instant when the output voltage of the compressor is suddenly changed and the instant when, after the sudden change, the output voltage passes the arithmetic mean value between initial and final values.

The nominal values of the times so measured are:

attack time: 1 ms;

recovery time: 2.8 ms.

The subject of tolerances for these values is a matter for further study.

The transient behaviour of the expander is observed with the compressor and expander interconnected. If the same steps are then applied to the compressor input, the signal at the expander output should not deviate from the final steady-state value by more than ±10%.

Note. — Since the initial and final values of the compressor output voltage in the case of this compandor are not in a 1:2 ratio because of the curved characteristic, the arithmetic means are here not 1.5 and 0.75, respectively, as in the case of the telephone compandor.

f) *Impedance at audio points*

The audio input impedance should be 600 ohms balanced with a minimum return loss of 26 dB.

g) *Attenuation distortion due to the sending and receiving equipments*

The total attenuation distortion introduced by a sending and a receiving equipment should not exceed the following ranges:

40 to 125 Hz: +0.5 to —0.7 dB;

125 Hz to 10 kHz: +0.3 to —0.3 dB;

10 to 15 kHz: +0.5 to —0.7 dB;

relative to the gain at 800 or 1000 Hz.

The total attenuation distortion of three sending and receiving equipments should not exceed the following ranges:

40 to 125 Hz:	+0.5 to −2 dB;
125 Hz to 10 kHz:	+0.5 to −0.5 dB;
10 to 15 kHz:	+0.5 to −2 dB.

h) *Suppression of carrier leaks*

Carrier leaks may in certain instances fall within the frequency band used for sound-programme transmission over a basic group. Methods for the suppression of these carrier leaks are still being studied.

B. Characteristics of a group link used to establish two 15-kHz type carrier frequency sound-programme circuits

The lining-up of international group links is described in Recommendation M.46 (*Green Book*, Volume IV) in which information is given on the loss/frequency characteristics which should be obtained. To comply with the attenuation/frequency characteristics of sound-programme circuits in accordance with Recommendation J.21, it may be necessary to include a small amount of additional equalization.

Group links on which circuit sections for 15-kHz sound-programme transmission are established should be selected from those in which there were carrier leaks at 68, 72 and 96 kHz.

The subject of carrier leaks and their suppression is receiving further study. (Question 12/XV.)

It is necessary to consider whether additional requirements for the characteristics of group links for 15-kHz sound-programme transmission is needed beyond those covered in Recommendation M.46 (for example, group delay distortion in the case of stereophonic transmission).

ANNEX 1
(to Recommendation J.31)

Single sideband system

(Contribution of the N.V. Philips Telecommunicatie Industrie)

This annex concerns a single-sideband sound-programme transmission equipment incorporating pre- and de-emphasis combined with a compandor characterized by a separate FM control channel.

The equipment operates on group links of carrier telephone systems.

Both peak and average loads to the group are compatible with those of the replaced telephone channels.

a) *Frequency allocation in the group*

	Modulated programme frequencies	Compandor control channel	Synchronizing pilot
Channel A (inverted)	65 ..... 79.96 kHz	81.39 ... 83.18 kHz	84 kHz
Channel B (erect)	88.04 ... 103 kHz	84.82 ... 86.61 kHz	

Channels A and B can be used for independent monophonic sound-programme circuits or combined into a stereophonic pair. Either channel A or B can be deleted and substituted by the corresponding telephone channels.

Group pilots at 84.08, 84.14 and 104.08 kHz and telephone channels 1 and 12 are compatible with this frequency allocation.

b) *Pre-emphasis*

Pre-emphasis takes place before compression by means of a network according to Recommendation J.17. The insertion loss at 800 Hz is 6.5 dB.

c) *Compandor*

1. *Steady-state characteristics*

The compandor has a separate frequency-modulated control channel containing the information on the degree of compression, as indicated in the table below.

Compressor input level (dBm0) [a]	Compressor gain (dB)	Control channel frequency (kHz)	
		Channel A	Channel B
$-\infty$	17	81.39	86.61
−40	17	81.39	86.61
−35	16.9	81.40	86.60
−30	16.7	81.41	86.59
−25	15.9	81.43	86.57
−20	13.5	81.52	86.48
−15	9.5	81.70	86.30
−10	4.8	81.94	86.06
− 5	0	82.24	85.76
0	− 4.9	82.56	85.44
+ 5	− 9.6	82.90	85.10
+10	−11.8	83.18	84.82
+15	−11.8	83.18	84.82

[a] The relative level at the compressor input to be considered is 6.5 dB higher than that corresponding to an 800 Hz audio-frequency test-tone.

With pre-emphasis and compressor, an audio input level of e.g. +6.5 dBm0(*s*) at 800 Hz will thus give rise to a compressor input level of 0 dBm0 and hence to a group level of −4.9 dBm0(*t*).

The level in the control channel is −17 dBm0(*t*).

The expander gain tracks that of the compressor with a tolerance of ±0.5 dB.

dBm0(*t*) denotes that the level quoted is referred to a 0 relative level point in a telephone channel.

dBm0(*s*) denotes that the level quoted is referred to the sound-programme circuit.

For the lowest programme levels, the total improvement in signal to noise ratio will be 19.8 dB (when weighting by means of a psophometer according to Recommendation P.53, B).

2. *Transient behaviour of the compressor*

Considering a 12 dB level step at the compressor input from −17 dBm0 to −5 dBm0 (point of unaffected level), the compressor attack time is defined as the time interval needed for the compressor output voltage to reach the arithmetical mean between initial and final values.

Taking the sudden level variation in the opposite direction yields the definition of the compressor recovery time.

The nominal values of attack and recovery time are respectively 2.4 and 4 ms.

3. *Transient behaviour of the expander*

With compressor and expander interconnected and when applying at the compressor input sudden level variations from −17 dBm0 to −5 dBm0 and vice versa, the expander output voltage should not deviate by more than 10% from the steady-state values.

d) *Synchronizing pilot*

A synchronizing pilot at 84 kHz with a level of −20 dBm0(*t*) is used in order to reduce frequency and phase errors due to the group link.

Frequency offset is reduced by a factor of 21.

At the transmitting and receiving terminals, the modulating and demodulating carriers should be phase-coherent with the synchronizing pilot in such a way that a frequency offset of 2 Hz does not give rise to a phase difference between the two channels of the stereophonic pair exceeding 1°.

ANNEX 2

(to Recommendation J.31)

Double-sideband system

(Contribution of L. M. Ericsson, I.T.T. and Telettra)

a) *Frequency allocation*

Double-sideband modulation of a carrier frequency of 84.080 kHz. The sidebands are located in the band 69.080–99.080 kHz. The carrier is reduced in level, so that it can be used in the normal way for a group pilot.

b) *Pre-emphasis*

The pre-emphasis curve given in Recommendation J.17 should be used.

c) *Compandors*

Compandors are not an integral part of these systems.

d) *Levels of programme signal in carrier system*

The levels are such that a sine wave of 800 Hz applied at the audio input with a level of 0 dBm0(*s*) will appear at the group output, having been through a pre-emphasis network, as two sideband frequencies each with a level of +2 dB compared to the relative level of the telephone channels, that is +2 dBm0(*t*). This level should be adjustable over a range of about ± 3 dB.

e) *Group regulation*

Normal group regulation is available using 84.080 kHz. This frequency had the normal level and tolerances for a pilot as given in Recommendation G.241, b and c.

f) *Carrier regeneration*

Different versions of this system rely respectively on the correct phase of the group pilot or on the use of an auxiliary pilot above the programme band (16.66 kHz or 16.8 kHz, for example, has been proposed for national systems); a frequency of 16.8 should be reconsidered for international use; the sending terminal should where necessary be adapted to meet the needs of the receiving terminal in either respect. The level of any auxiliary pilot should not exceed −20 dBm0(*t*), i.e. referred to the telephone channel level in the group.

ANNEX 3

(to Recommendation J.31)

Particular double sideband system

(Contribution of Società Italiana Telecomunicazioni Siemens S.p.A.)

This system makes it possible to set up one high quality monophonic programme circuit or a pair of stereophonic circuits on a telephone basic group.

The monophonic programme circuit may be realized either employing single sideband or double sideband transmission. In the first case the monophonic programme circuit may be established either in the upper or in the lower band. In the second case, the system has the same characteristics of the double sideband systems (described in Annex 2) with which it may be interconnected.

The system is usually employed in Italy for the transmission of five programmes of the wire broadcast transmission, on the five basic primary groups of any supergroup.

In Italy one of these programmes is used as stereophonic. Links have been accomplished which permit transmission on the already existing FDM main and local network.

The measurement carried out shows that the system complies broadly with the values recommended by the C.C.I.T.T. Recommendation J.21 for the high quality circuits with equipment whose price renders the system economical, also for distances of some hundreds of kilometres.

Note. — The system is described in C.C.I.T.T. Contribution COM XV-No. 139 (1968-1972 period).

Recommendation J.32 (formerly J.22 of the *White Book*; amended at Geneva, 1964, and at Mar del Plata, 1968)

CHARACTERISTICS OF EQUIPMENT AND LINES USED FOR SETTING UP 10-kHz TYPE SOUND-PROGRAMME CIRCUITS

10-kHz type sound-programme circuits can be provided in wideband cables by the following methods:

a) *Special pairs for sound broadcasting*

If a broadcast programme is to be distributed to a number of intermediate points along the line (if this includes carrier telephone systems), it may be necessary to use a pair of conductors with a special screen for programme transmissions; or it may happen that it is preferable to transmit the broadcast programme over the carrier system itself or on the phantom of the unloaded pairs.

It should be remembered, however, that interstice pairs in a coaxial cable are principally intended for the maintenance and supervision of the telephone carrier system routed over the coaxial pairs.

b) *10-kHz sound-programme circuits routed over channels of a carrier telephone system in cable*

It is recommended to use the frequency band corresponding to three telephone channels of a carrier system to form a 10-kHz type sound-programme circuit. One such assembly of three channels may be used in this manner in a 12-circuit group.

The C.C.I.T.T. has already recommended the position defined below as Position I for this assembly of three channels to provide programme transmission in basic group B.

Position I: Frequency band used: 84-96 kHz

Virtual carrier frequency: 96 kHz

The C.C.I.T.T. no longer recommends the use of Position II, defined in the old recommendation (*Red Book*, Volume III), in the international service.

The C.C.I.T.T. recommends also the following frequency arrangements in the basic group B:

Position III: Frequency band used: 84-96 kHz

Virtual carrier frequency: 95.5 kHz

This position may be adopted whether a compandor is used or not.

Supplement No. 12 of this Volume indicates the improvement in crosstalk to be expected from offset of the carrier frequency and in particular from the use of Position III.

Note. — Some Administrations use a pilot inserted in the audio-frequency part of the sound-programme modulation equipment for the purpose of regulating the equivalent and supervising the link as a whole.

While, generally speaking, the provision of automatic group regulation should suffice to ensure satisfactory stability of the equivalent, a pilot like the one suggested by one of these Administrations might be useful when compandors (which increase variations of the equivalent) are used, or when the switching of sound-programme circuits to RF is envisaged or when frequency synchronization is required between the ends of the circuit.

With the limit that has been given in Recommendation J.14 for the "peak voltage" transmitted by one such assembly of three channels, these assemblies (used for sound-programme transmissions) may be placed in any basic group (or in all the basic groups) of a supergroup (or in all supergroups) of a carrier system on coaxial cable.

The C.C.I.T.T. has not limited the possible positions (in the basic supergroup) of the groups over which 10-kHz type sound-programme circuits can be routed but it can be said that the basic groups (in a supergroup) which appear most appropriate for such circuits are groups 2, 3 and 4. These groups are subject to less attenuation distortion at the edges (produced by certain filters in the supergroup) than groups 1 and 5. The most appropriate supergroups in which to place the sound-programme circuits are those which are transmitted on the coaxial cable with the lowest carrier frequencies, because the frequency deviation (due to instability of the frequency generators) on the channels of these groups will be proportionately lower than the deviation on channels in supergroups transmitted at a high frequency. Supergroup 2 (the basic supergroup) has the additional advantage of having one stage of modulation less than the other supergroups.

In the case of a carrier system on symmetric pairs, it may be necessary to make a special choice of the group of the system and the pairs to be used in order that the conditions concerning crosstalk for the complete sound-programme circuit will be satisfied. (See Recommendations J.22 and J.18.)

c) *Use of phantom circuits on unloaded symmetric pairs equipped with carrier systems*

Experience has shown that the phantom circuits of symmetric pairs in cables equipped with carrier systems may allow transmission (as defined in Recommendation J.22, a) from 50 Hz to 10 000 Hz. These circuits have the advantage that derivations at various repeater stations of the carrier system can easily be made, thus allowing the distribution of a radio programme or the picking up of a supplementary programme at various points along the line.

When such phantom circuits are used over long distances, it may be necessary to provide manual or automatic regulation to compensate for changes of attenuation with time.

d) *Use of the band of frequencies below 12 kHz*

The use of phantom circuits (see paragraph c) naturally depends on a multiple twin or a star quad cable being available. If only a pair cable is available, a possible solution would be to place the sound-programme transmission in the frequency band below 12 kHz, i.e. below the frequency band used for the carrier telephone channels; but this solution involves difficulties with filters or with crosstalk balancing frames, if any exist.

Recommendation J.33 (formerly J.31, A of the *White Book*; amended at Geneva, 1972)

CHARACTERISTICS OF EQUIPMENT AND LINES USED FOR SETTING UP 6.4-kHz TYPE SOUND-PROGRAMME CIRCUITS

The C.C.I.T.T. recommends that, when an Administration wishes to provide a sound-programme circuit transmitted on a carrier system, using a frequency band corresponding to two telephone channels, the circuit should occupy the frequency range 88 kHz to 96 kHz in basic 12-channel group B frequency band and the virtual carrier frequency within this range should be 96 kHz, or as an alternative, 95.5 kHz. [1]

[1] For the choice of groups and supergroups used, see Recommendation J.32.

PART II

International television transmissions

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SUMMARY

Chapter 1 — OPERATION

(Recommendation in Volume II-A of the *Green Book*)

Chapter 2 — MAINTENANCE

(Recommendations in Volume IV.1 of the *Green Book*)

Chapter 3 — TRANSMISSION

(Recommendations in Volume III of the *Green Book*)

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CHAPTER 1

OPERATION

(For operation of international television-programme transmissions, see Chapter 1 "Operation", Part I of this Compendium, which contains Recommendation E.330, valid for both sound and television programme transmissions.)

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CHAPTER 2

MAINTENANCE

2.1 International television transmissions—Definitions and responsibilities

Recommendation N.51

DEFINITIONS [1] FOR APPLICATION TO INTERNATIONAL TELEVISION TRANSMISSIONS

The following definitions apply to international television transmissions:

a) *international television transmission*

The transmission of television signals over the international telecommunication network for the purpose of interchanging television material between broadcasting organizations in different countries.

b) *broadcasting organization* [2] *(send)*

The broadcasting organization at the sending end of the international television connection.

c) *broadcasting organization (receive)*

The broadcasting organization at the receiving end of the international television connection.

d) *international television centre (I.T.C.)*

A centre at which at least one international television circuit terminates and in which international television connections can be made by the interconnection of international and national television circuits.

The I.T.C. is responsible for setting-up and maintaining international television connections and for the supervision of the transmissions made on them.

[1] The nomenclature adopted by C.C.I.T.T. Study Group IV for international television transmission is not in accordance with that used by the C.C.I.R. in this text. The equivalent expressions are as follows:

C.C.I.R.	*C.C.I.T.T. (Volume IV)*
—	circuit-section
link	circuit
circuit	link
connection	connection
local line	national television circuit

Thus the " C.C.I.R. hypothetical reference circuit " is an assembly corresponding to a C.C.I.T.T. Study Group IV " international television link " in that it comprises three independently maintained international television circuits connected together at an I.T.C. without the need, in principle, for adjustment or correction.

[2] For the purposes of these N Series recommendations the term " broadcasting organization " should be taken as referring to an organization concerned with television and/or sound-programme transmissions.

e) *international television connection* (Figure 2/N.51)

The unidirectional path between the broadcasting organization (send) and the broadcasting organization (receive) comprising the international television link extended at its two ends over national television circuits to the broadcasting organizations.

f) *international television link* (Figure 2/N.51)

The unidirectional transmission path for television transmissions between the I.T.C.s of the two terminal countries involved in an international television transmission. The international television link comprises one or more international television circuits interconnected at intermediate I.T.C.s.

g) *international television circuit* (Figure 1/N.51)

The unidirectional transmission path between two I.T.C.s and comprising one or more television circuit-sections (national or international), together with any necessary video equipment.

h) *television circuit section* (Figure 1/N.51)

Part of an international television circuit between two stations at which the programme is transmitted at video frequencies.

i) *international multiple destination television connection* (Figure 4/N.51)

The unidirectional television transmission path between the broadcasting organization (send) and two or more broadcasting organizations (receive) comprising the international multiple destination television link extended at its ends over national television circuits to the broadcasting organizations.

j) *international multiple destination television link* (Figure 4/N.51)

The unidirectional television transmission path between the I.T.C.s of the terminal countries involved in an international multiple destination television transmission via communication satellite. The international multiple destination television link comprises international television circuits, one of which is an international multiple destination television circuit.

k) *international multiple destination television circuit* (Figure 3/N.51)

The unidirectional television transmission path from one I.T.C. to two or more other I.T.C.s comprising television circuit sections (national or international) one of which is an international multiple destination circuit section, together with any necessary video equipment.

l) *international multiple destination television circuit section* (Figure 3/N.51)

The unidirectional television transmission path via a multiple destination communications satellite from one frontier station to two or more other frontier stations at which the television programme appears at video frequencies.

m) *send reference station* (Figures 3/N.51 and 4/N.51)

The terminal sub-control station of a multiple destination television circuit section, circuit, or link.

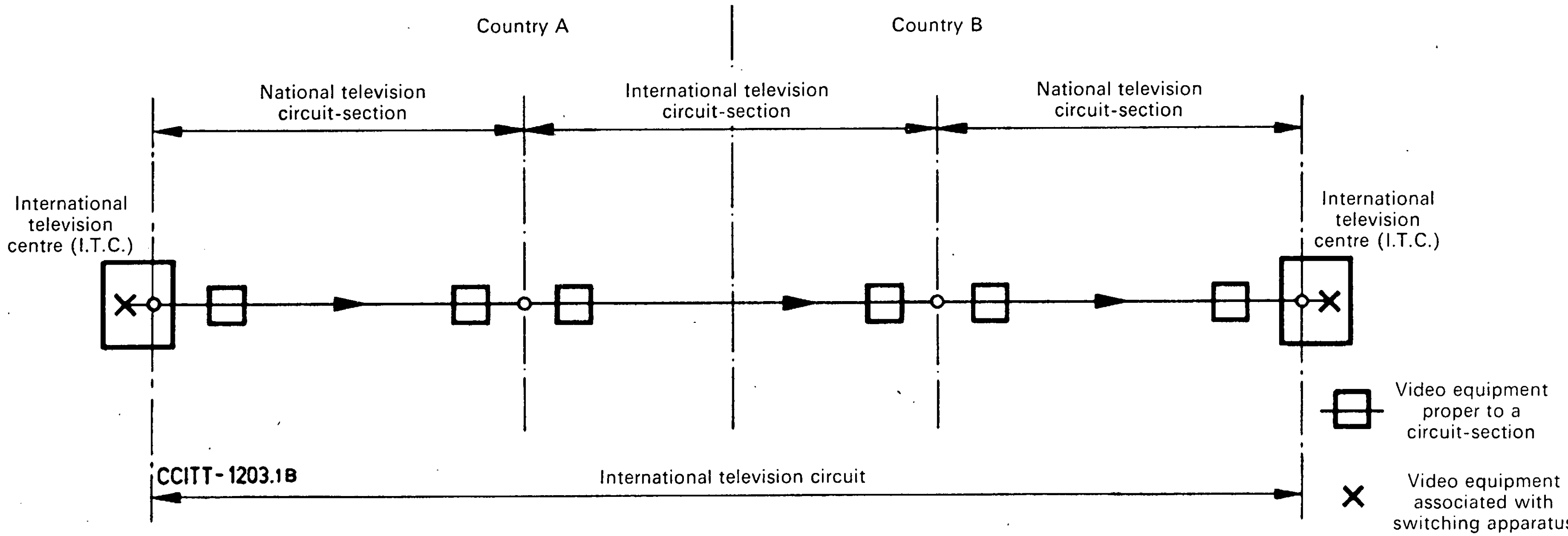


FIGURE 1/N.51. — **An international television circuit composed of two national and one international television circuit-sections.**

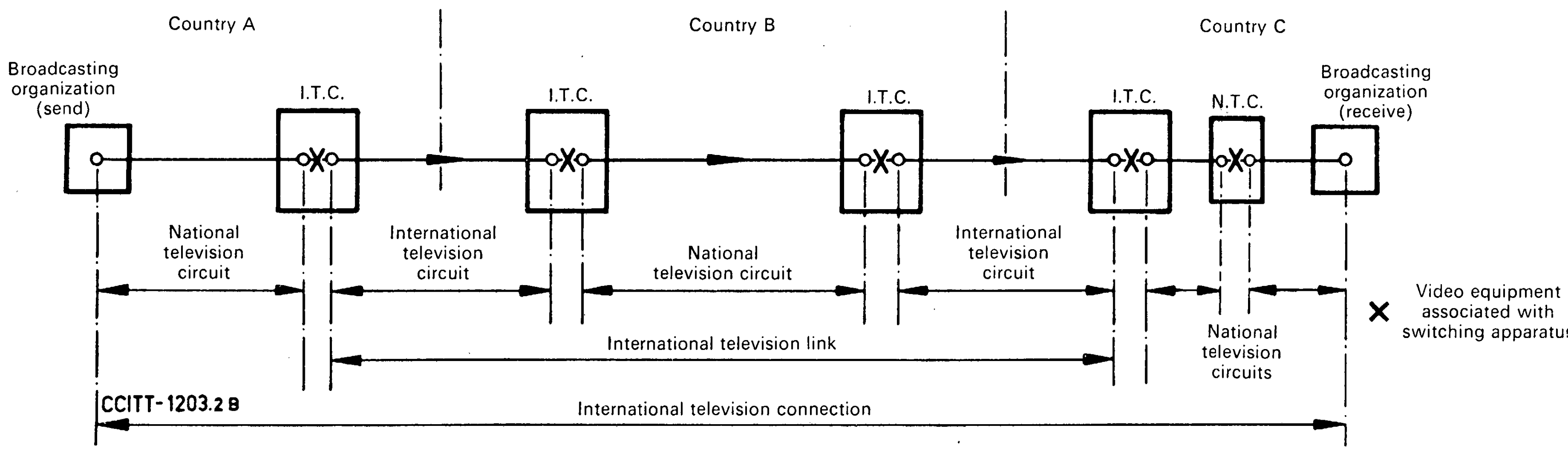
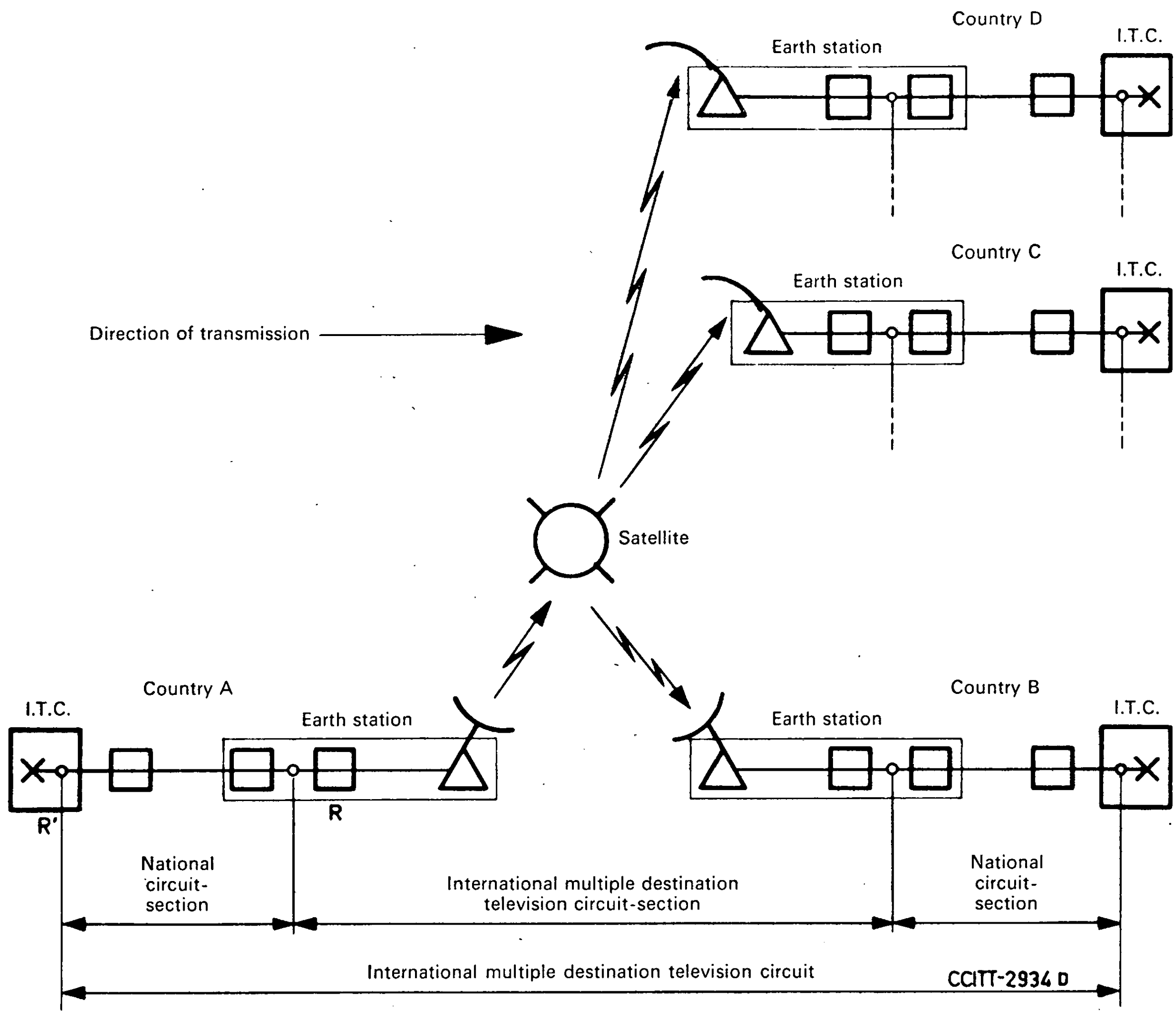


FIGURE 2/N.51. — **An international television link composed of international and national television circuits and extended on national television circuits at each end to form an international television connection.**



= Video equipment proper to circuit-section

× = Video equipment associated with switching apparatus

I.T.C. = International television centre

R = Send reference station for international circuit section

R′ = Send reference station for international circuit

FIGURE 3/N.51. — **International multiple destination television circuit comprising an international multiple destination satellite circuit-section and national terrestrial circuit-sections.**

R′ = Send reference station for international multiple destination circuit
R″ = Send reference station for international multiple destination link
I.T.C. = International television centre
N.T.C. = National television centre
X = Video equipment associated with switching apparatus

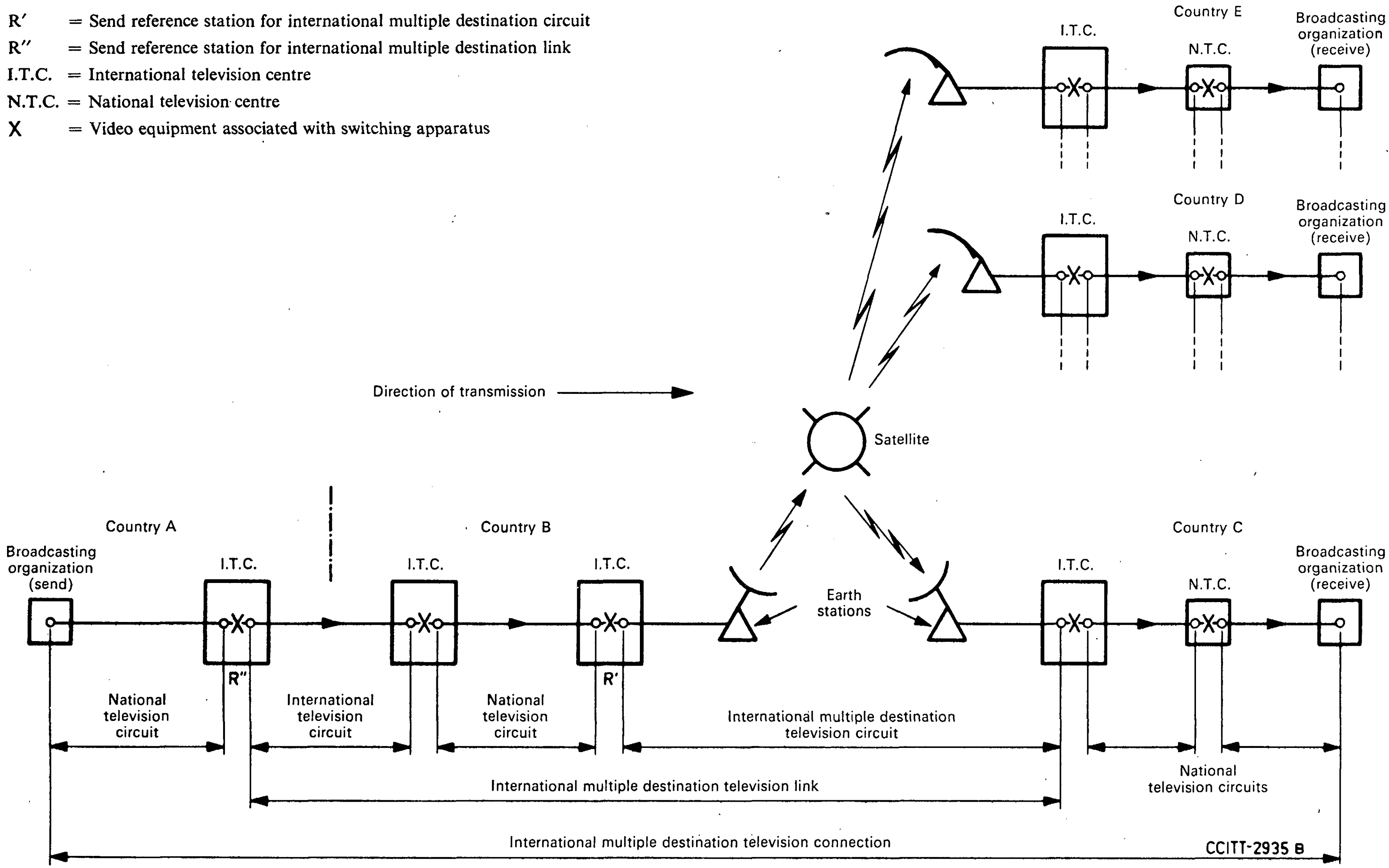


FIGURE 4/N.51. — **An international multiple destination television link composed of an international multiple destination television circuit and national and international television circuits extended on national circuits at each end to form an international multiple destination television connection.**

Recommendation N.52

MULTIPLE TELEVISION TRANSMISSIONS AND COORDINATING CENTRES

A multiple television transmission occurs when the same programme is transmitted to several broadcasting organizations, for broadcasting by their transmitting stations or for making recordings.

If the branching point of the television transmission is at the originating point of the programme each unidirectional path to a receiving broadcasting organization is considered to be an individual international television connection.

Otherwise, the term " derived television transmissions " is used. The telecommunication Administrations concerned should agree on the choice of a control station. The branching points will be sub-control stations. To meet the needs of the telecommunication Administrations, the control station should have the necessary staff and appropriate control circuits to the sub-control stations for the different sections.

The designation of the coordinating centre is a matter for the broadcasting organization. The functions of a coordinating centre are:

— to coordinate the requests made by the broadcasting organizations participating in the transmission concerned,

— to make all necessary enquiries as to the availability of television circuits,

— to draw up the plan of the network of telephone circuits, sound-programme circuits and television circuits, required for the transmission in question,

— to ensure that the television transmission proceeds normally once the international television connections are handed over to the broadcasting organization,

— immediately to call in the control station and sub-control station concerned, in the event of breakdown or complaints concerning the technical performance of the connections.

Recommendation N.54

DEFINITION AND DURATION OF THE LINE-UP PERIOD AND THE PREPARATORY PERIOD

1. *Definition*

For each international television transmission a distinction is made between:

a) the *line-up period* during which the telecommunication Administrations line up the international television link before handing it over to the broadcasting organizations;

b) the *preparatory period* during which the broadcasting organizations carry out their own adjustments, tests, etc., before the television transmission itself commences.

The exact time at which the preparatory period begins (point H on Figure 1/N.54) is determined by the broadcasting organizations.

2. *Line-up period*

It is provisionally recommended that in principle, the duration of the line-up period should nominally be thirty minutes, sub-divided into two periods, for the operations described below (see Figure 1/N.54).

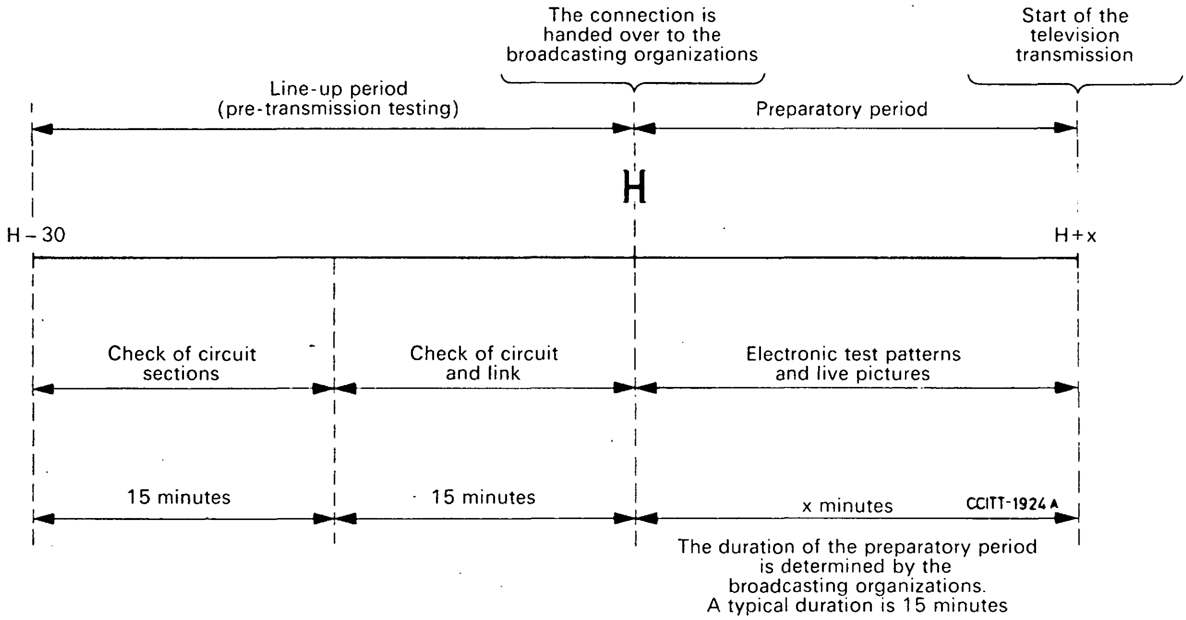


FIGURE 1/N.54. — **Time allocation in the line-up period and the preparatory period in the case of television transmissions.**

H–30 to H–15 — Concurrent lining-up of the national and international circuit sections that will be used to constitute the international television circuit. The international circuit sections may or may not include a communications satellite. The tests to be made are those given in Recommendation N.62. Tests between the earth stations of a communications satellite circuit section are not the responsibility of the C.C.I.T.T. but these tests also should be completed by time H–15.

H–15 to H — Interconnection of the circuit sections to be used, confirmation that the international television circuit is continuous between the terminal I.T.C.s and overall tests between the control I.T.C. and the sub-control I.T.C. The tests to be made are those given in Recommendation N.62 [1].

The above periods " H–30 to H–15 " and " H–15 to H " are indicated for guidance only. Their duration is based on an estimate of the time necessary to perform the tests in Recommendation N.62 with a reasonable allowance for adjustments. No allowance is included for the removal of fault conditions on the circuit sections or on the complete circuit or link.

These periods also assume a configuration of the international television circuit [2] consisting of one international circuit section extended at each end by one national circuit section. In the case of television transmissions involving more than two countries, either or both of the nominal periods H–30 to H–15 and H–15 to H may have to be increased. On the other hand, in particular cases, either or both of these nominal periods may be reduced, by agreement between the Administrations concerned, provided the line-up is properly carried out. This may be possible, for example, when there are two successive international television transmissions on the same route, and the second involves extending the international television circuit or link already lined-up for the first.

During the last few minutes of the nominal period H–15 to H, when the above tests have been completed, the control and sub-control I.T.C.s [3] should put the link through to the broadcasting organization at each end and should confirm that the complete connection is continuous. It should be verified that the link [2] is satisfactory for transmitting the programme, and that the quality and level are acceptable.

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[1] See the comment in Recommendation N.62 concerning the difficulties involved in making overall tests on circuits that include a standards converter.

[2] According to the Study Group IV definition, in this particular case, the " international television circuit " is also an international television link.

[3] See Recommendation N.55 for definition of control and sub-control I.T.C.s.

By agreement between the telecommunication Administration and the sending broadcasting organization, it might be desirable, during these last few minutes before the end of the line-up period, to transmit live pictures. This would be of particular use when adjusting standards converters. The transmission of live pictures during the line-up period does not, however, alter the telecommunication Administrations' responsibility with regard to the quality of transmission required. This responsibility begins only at time H, when the line-up period ends and the preparatory (service) period begins, and when the link is handed over to the broadcasting organizations.

3. *Preparatory period*

No definite duration is recommended by the C.C.I.T.T. for the preparatory period. This duration is determined by the broadcasting organizations, but a typical duration is 15 minutes. During this period, the tests to be made are also left to the discretion of the broadcasting organizations, but they must not be such as to depart from C.C.I.T.T. recommendations in respect of signal level (see Recommendations N.60 and N.63). The broadcasting organizations may, on occasion, omit the preparatory period and begin the actual transmission at time H.

Recommendation N.55

ORGANIZATION, RESPONSIBILITIES AND FUNCTIONS OF CONTROL AND SUB-CONTROL I.T.C.s AND CONTROL AND SUB-CONTROL STATIONS FOR INTERNATIONAL TELEVISION CONNECTIONS, LINKS, CIRCUITS AND CIRCUIT-SECTIONS

1. *Organization*

1.1 The international television link is in all cases the sole responsibility of the telecommunication Administrations involved.

1.2 The national television circuits at the ends of the link may be the responsibility of either the telecommunication Administration or the broadcasting organization or the two together, depending on local arrangements in each particular country.

1.3 The I.T.C. at the receiving end (Country C in Figure 2/N.51) is normally the control station for both the international television link and the international television connection and is referred to as the control I.T.C. The choice of the station which is to have this function is left to the discretion of the Administration concerned.

1.4 The intermediate I.T.C.s, where the international circuit appears at video frequencies, are sub-control stations for the international television link and are referred to as intermediate sub-control I.T.C.s.

1.5 Circuit-sections, including satellite sections, also have control and sub-control stations. From the standpoint of overall control arrangements for an international television link, a station controlling a circuit-section is referred to herein as an intermediate sub-control station.

1.6 The I.T.C. at the sending end (Country A in Figure 2/N.51) is normally the sub-control station for both the international television link and the international television connection. It is also referred to as the terminal sub-control I.T.C. However, the choice of the station which is to have this function is left to the discretion of the Administration concerned.

2. *Responsibilities*

2.1 The control I.T.C. is responsible to the broadcasting organization-receive for the satisfactory performance of the overall international television connection. When an international television connection does not include a satellite section, the control I.T.C. should exert control through intermediate sub-control I.T.C.s, and stations, on that portion of the international television connection extending from the terminal sub-control I.T.C. to the broadcasting organization-receive. When an international television connection does include a satellite section, the control I.T.C. should exert control through intermediate sub-control I.T.C.s, and stations, on that portion of the international television connection extending from the transmitting earth station to the broadcasting organization-receive.

2.2 When an international television connection does not include a satellite section, control of that portion of the international television connection extending from the broadcasting organization-send to the terminal sub-control I.T.C. should be exerted through the terminal sub-control I.T.C. When an international television connection does include a satellite section, control of that portion of the international television connection extending from the broadcasting organization-send to the transmitting earth station should be exerted through the terminal sub-control I.T.C. In each case, the terminal sub-control I.T.C. is, in turn, responsible for the satisfactory performance of that portion of the connection over which the terminal sub-control I.T.C. has control responsibility; the terminal sub-control I.T.C. should coordinate the activities of any intermediate sub-control I.T.C.s, and stations, both prior to and during the transmission, thus assisting the control I.T.C. and keeping that office informed of developments.

2.3 The receive earth station is the control station for the satellite circuit-section. Reference to the control station for the satellite circuit-section is intended to apply to the station, or portion of the station, manned by personnel of the satellite operator.

2.4 Any intermediate sub-control I.T.C.s, and other intermediate sub-control stations, are responsible for the satisfactory performance of their respective circuits and circuit-sections. In the operation of an international television connection, any sub-control I.T.C.s and stations which are intermediate are responsible to either the terminal sub-control I.T.C. or the control I.T.C., depending upon their location in the overall connection.

3. *Functions*

3.1 All stations which are designated as control and sub-control stations on an international television connection should perform the following functions:

- Ensure that sections under each respective control are conditioned for service and connected into the international television connection at the appropriate time.
- Time the start and conclusion of the transmission in accordance with paragraph 5 below.
- Keep complete and accurate records of all station activities pertaining to the international television transmission. This should include timing and recording service impairment observed or reported, and taking corrective action under the direction of the control or terminal subcontrol I.T.C.
- Prepare and forward prescribed reports.

3.2 Control and terminal sub-control I.T.C.s on an international television connection should perform the following additional functions:

- Verify the scheduling of the television transmission and the availability of information necessary to furnish it.

— Perform and coordinate, as required, prescribed pre-transmission line-up tests.

— Check the satisfactory receipt, by the broadcasting organization-receive, of the test programme originated by the broadcasting organization-send.

— Ensure that the international television connection is handed over to the broadcasting organizations at the scheduled time.

3.3 It will be the responsibility of the terminal control I.T.C. to see that adequate communications facilities are provided. In those instances, where permanent direct service circuits are not provided and the television service is of an infrequent nature, use of the public telephone network should be encouraged as a means of linking the two terminal I.T.C.s.

In order to perform these functions satisfactorily it is essential that adequate, direct, and rapid communications be provided between terminal I.T.C.s during the line-up period and service period. The service circuits between terminal I.T.C.s referred to here should be as specified in Recommendation M.10 as *Direct Service Circuit*. The service circuit requirement for television is analogous to the service circuit requirement described in Recommendation M.10 for the telephone network.

4. *Pre-transmission procedures*

4.1 At some time prior to the scheduled start of television transmission, preferably the day before but not less than two hours prior to the start of service, the control I.T.C. should contact the terminal sub-control I.T.C. and the appropriate intermediate sub-control I.T.C.s or stations, over which he exercises control and confirm that they have the transmission schedule and sufficient information to furnish the service. Similarly, the terminal sub-control I.T.C. should contact the intermediate sub-control I.T.C.s or stations over which he exercises control to verify their readiness.

4.2 The control and sub-control I.T.C.s should initiate circuit-section line-up tests for which they are directly responsible. These tests should be commenced far enough in advance of the scheduled time at which the connection is handed over to the broadcasting organization (point H in Figure 1/N.54) to be completed not later than 15 minutes prior to the scheduled start of television transmission (H + X on Figure 1/N.54). During this same period the control station for any satellite circuit-section should perform line-up tests as prescribed by the responsible authority. The tests recommended for terrestrial circuit-sections and I.T.C. to I.T.C. links are those detailed in Recommendation N.62.

4.3 Immediately upon conclusion of the circuit-section tests, the control I.T.C., with the cooperation of the terminal sub-control I.T.C., should verify that the international television link is continuous between these terminal I.T.C.s and should then proceed to perform overall line-up tests as detailed in Recommendation N.62.

4.4 Upon completion of the overall tests, and if possible 2 or 3 minutes prior to the scheduled start of the transmission from the broadcasting organization-send, the control and sub-control I.T.C.s should establish the connection to the broadcasting organizations and check test programme between them. Checking test programme consists of verifying the satisfactory receipt, from the standpoints of quality and level, by the broadcasting organization-receive of test material originated by the broadcasting organization-send. The sub-control I.T.C. should request this transmission of test material from the broadcasting organization-send, as necessary, and should verify that the material is of suitable quality and level at his location. The control I.T.C. should also check for suitable quality and level at his location. Having determined that the test programme check is satisfactory, the connection should be handed over to the broadcasting organizations.

5. *Timing the international television transmission*

5.1 The control I.T.C. and terminal sub-control I.T.C. of the international television-connection should record the times of start and conclusion of the transmission, in Greenwich Mean Time (GMT).

5.2 The starting time-of-day of the service may be the scheduled time shown on the service order, or the time at which the broadcasting organizations commence to use the service, whichever is earlier. If the connection is not ready for use on schedule, and is handed over to the broadcasting organizations after the scheduled time of start shown on the service order, then the start of service is the time-of-day at which the connection is handed over to the broadcasting organizations.

5.3 The concluding time of the service is the time at which the connection is released by the broadcasting organization-receive (end of chargeable duration—sometimes called the " Good-night time ").

The conditions for the provision and lease of circuits for television transmissions are given in Recommendation E.330 of Volume II-A of the C.C.I.T.T. *Green Book.*

6. *Monitoring*

6.1 The control I.T.C. should monitor in connection with the pre-transmission check of test television programmes and continuously thereafter until the conclusion of the transmission. Continuous monitoring at other stations is not required, except as directed by their respective Administrations, and as required to discharge their responsibilities with regard to fault location.

7. *Fault location and handling*

7.1 The control and sub-control I.T.C.s and stations are responsible for recording times of day and details of service impairments observed and/or reported to them and for initiating corrective actions. However, except when the impairment has rendered the programme unusable, no action which would interrupt the transmission path should be taken except at the direction of the control I.T.C.

7.2 Although composed of a variety of national and/or international circuits and circuit-sections, an overall international television connection without a satellite section may be divided into two segments:

a) The terrestrial facilities between the broadcasting organization-send and the terminal sub-control I.T.C.

b) The terrestrial facilities between the terminal sub-control I.T.C. and the broadcasting organization-receive.

When an overall international television connection includes a satellite section the connection may be divided into three major segments:

a) The terrestrial facilities between the broadcasting organization-send and the transmitting earth station.

b) The satellite circuit-section between earth stations.

c) The terrestrial facilities between the receiving earth station and the broadcasting organization-receive.

7.3 Faults encountered during service will be observed by the broadcasting organization-receive and reported to the control I.T.C. or observed by the control I.T.C., or both.

7.4 Normal fault sectionalization for an overall connection without a satellite section, should be as follows:

— The control I.T.C. shall immediately check the television signal at his location to determine if the fault lies between the broadcasting organization receive and the control I.T.C. If the signal is satisfactory at the control I.T.C., further sectionalization is carried out by the control I.T.C. directly or via sub-control stations, should they exist, between the control I.T.C. and the broadcasting organization-receive.

— If the signal is unsatisfactory as it appears incoming to the control I.T.C., the control I.T.C. shall determine from the terminal sub-control I.T.C. whether the signal is satisfactory as it arrives at the terminal sub-control I.T.C. If the signal incoming to the terminal sub-control I.T.C. is unsatisfactory, the terminal sub-control I.T.C. shall futher sectionalize the fault between the broadcasting organization-send and the terminal sub-control I.T.C. Such sectionalization shall begin by checking the television signal at its source.

— If the signal incoming to the terminal sub-control I.T.C. is satisfactory, the control I.T.C. should further sectionalize the fault via the appropriate intermediate sub-control I.T.C.s, or stations, and take whatever corrective action is indicated.

7.5 Normal fault sectionalization for an overall international connection containing a satellite section, should be as follows:

— The control I.T.C. shall immediately check the television signal at his location to determine if the fault lies between the broadcasting organization-receive and the control I.T.C. If the signal is satisfactory at the control I.T.C., further sectionalization is carried out by the control I.T.C. directly or via sub-control stations, should they exist between the control I.T.C. and the broadcasting organization-receive.

— If the signal is unsatisfactory as it appears incoming to the control I.T.C., the control I.T.C. shall determine from the terminal sub-control I.T.C. whether the signal is satisfactory as it arrives at the terminal sub-control I.T.C. If the signal incoming to the terminal sub-control I.T.C. is unsatisfactory, the terminal sub-control I.T.C. shall further sectionalize the fault between the broadcasting organization-send and the terminal sub-control I.T.C. Such sectionalization shall begin by checking the television signal at its source.

— If the signal incoming to the terminal sub-control I.T.C. is satisfactory, the terminal sub-control I.T.C. should contact the transmitting earth station to determine if the signal is unsatisfactory incoming to that station; simultaneously, the control I.T.C. should contact the receiving earth station to determine if the signal is satisfactory incoming to the receiving earth station.

— If the fault locates between the terminal sub-control I.T.C. and the transmitting earth station, the terminal sub-control I.T.C. shall contact the appropriate intermediate sub-control I.T.C.s or stations, to further sectionalize the fault and take whatever corrective action is indicated.

— If the fault is located in the satellite circuit-section, the control I.T.C. should request the receiving earth station (satellite section control) to take corrective action.

— If the fault is located between the receiving earth station and the control I.T.C., the control I.T.C. should contact the appropriate intermediate sub-control I.T.C.s or stations, to further sectionalize the fault and take whatever corrective action is indicated.

7.6 Intermediate sub-control I.T.C.s and stations should keep the I.T.C.s, to which they are subordinate in the provision of the television service, informed of the status of the fault investigation. Similarly, the control I.T.C. should keep the broadcasting organization-receive informed. In so doing these stations and I.T.C.s should exchange times-of-day at which faults are encountered, and should attempt to reconcile any differences.

8. *Record keeping*

8.1 The several telecommunication Administrations will prescribe the reports required from their respective stations and the distribution to be made of these reports. To a considerable extent, however, the subject content of these reports will be essentially the same. The following paragraphs will suggest the records of television transmissions to be kept by the stations, and to some extent the information from which the prescribed reports can be prepared.

8.2 The reports prepared by the control I.T.C. normally will provide the information from which bills rendered to the broadcasting organizations will be prepared, including any credit allowances for any transmission interruptions or other serious impairments experienced. Usually a carefully kept and detailed log record in itself will constitute a satisfactory source for this purpose.

8.3 The terminal sub-control I.T.C. and the intermediate sub-control I.T.C.s and stations should also keep detailed log records of their activities in connection with each television transmission. Thus, whether or not these stations are required by their Administrations to submit reports, any needed information will be available to satisfy inquiries or investigations which may arise subsequent to transmissions.

8.4 The following paragraphs suggest the nature and extent of the log record detail. Times-of-day should be shown to the second, in GMT; the record should be kept chronologically from the beginning of service preparations to the final exchange of times of day and comments. Abbreviations and condensations should be used carefully and discreetly; initials or names should identify the recorder.

8.5 Record exchanges and discussions with other stations and with broadcasting organizations. These records should include initials, names or other identification of the individuals contacted.

8.6 Record the results of pre-transmission tests, including the test programme check.

8.7 In recording the times of programme start and conclusion, indicate when agreement is reached with other stations or with broadcasting organizations with respect to these times. Where discrepancies cannot be reconciled, record the differing times with suitable identification of each.

8.8 In recording the details of impairments observed or reported, include such details as:

- time and duration,
- time the report was received,
- nature and grade of impairment, indicating video or audio,
- assessment by the broadcasting organization as to whether the impairment rendered the programme unusable (an assessment of " unusable " is not acceptable if the programme was used despite the impairment).
- any other information which may prove helpful in a subsequent analysis.

8.9 Record the quality assessment of the overall transmission given by the broadcasting organization-receive, using the quality assessment scale [1].

8.10 The log record of each station at which the transmission was monitored continuously should include the assessment of the overall transmission by the attendant at that station using the quality asessment scale [1].

[1] See Recommendation N.64 for Impairment and Quality Scales.

9. *Responsibilities of control and sub-control stations for multiple destination transmissions*

9.1 International multiple destination transmissions on communications satellite systems differ in a number of respects from those routed on terrestrial systems. A common transmitting path extends from the terminal I.T.C. sub-control station through the transmitting earth station to a satellite repeater and separate receiving paths extend from the satellite repeater through the applicable receiving earth station to a number of terminal I.T.C. control stations (Figure 4/N.51). Operations on the common path will affect transmission to all the receiving stations whereas operations on any receiving path will only affect transmission to the terminal I.T.C. control station on the particular path concerned. To coordinate the setting-up, lining-up and maintenance of a multiple destination transmission on a communications satellite system, it is recommended that a send reference station be designated for each multiple destination circuit section, circuit and link.

The responsibilities of a send reference station are given in paragraph 9.2. The additional responsibilities and functions of control stations for a multiple destination television transmission are contained in paragraph 9.3.

9.2 *Send reference stations*

i) The send reference station for a multiple destination television circuit section is the intermediate circuit sub-control station, at the transmitting earth station (R in Figure 3/N.51).

ii) The send reference station for a multiple destination television circuit and link is the terminal sub-control station for the circuit and link respectively (R′ and R″ in Figure 4/N.51).

In addition to the normal control and sub-control station responsibilities specified in this recommendation, stations designated as send reference stations are required to perform the following functions:

a) Coordinate the setting-up, and lining-up, of the multiple destination circuit section, circuit or link.

b) Coordinate maintenance action on the multiple destination circuit-section, circuit or link when requested by the control stations.

c) Keep records of measurements made during the initial line-up of the multiple destination circuit section, circuit or link and incidents reported by the control stations during transmissions.

9.3 *Additional responsibilities of control stations*

In addition to the control station responsibilities in paragraphs 1 to 8 above, the control stations of multiple destination circuit sections, circuits or links, having a designated send reference station should perform the following functions:

a) Report to the appropriate send reference station the results of line-up measurements made on the multiple destination circuit section, circuit or link.

b) Report any incidents observed during transmissions to the appropriate send reference station.

c) Cooperate with the appropriate send reference station in locating fault conditions.

2.2 Line-up, supervision, charging and release of an international television connection

It is assumed that the international television connection is as shown in Recommendation N.51. It is also assumed that the various circuits to be interconnected to constitute the international television connection are permanent circuits that are regularly maintained.

Recommendation N.60

NOMINAL AMPLITUDE OF VIDEO SIGNALS AT VIDEO INTERCONNECTION POINTS

At video interconnection points, the nominal amplitude of the picture signal, measured from the blanking level to the white level should be 0.7 V (0.714 V for system M signals), while the nominal amplitude of the synchronizing pulses should be 0.3 V (0.286 V for system M signals), so that the nominal peak-to-peak amplitude of a monochrome video signal should be 1.0 V. The addition of colour information results in an increase in the overall amplitude of the video signal. The magnitude of this increase depends upon the colour system employed, but should not exceed 25% (i.e. nominal amplitude of composite colour video signal $\leqslant$ 1.25 V). Figure 1/N.60 shows waveform of video signal.

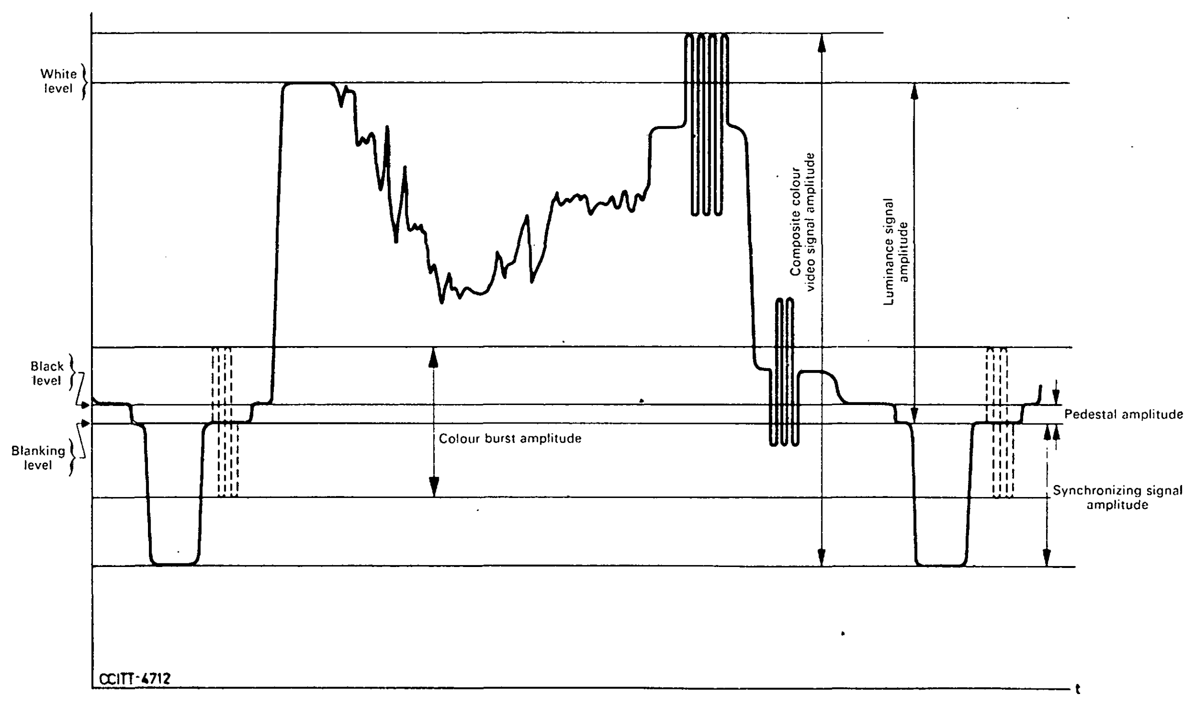


FIGURE 1/N.60. — Waveform of one line of video signal.

Recommendation N.61

MEASUREMENTS TO BE MADE BEFORE THE LINE-UP PERIOD THAT PRECEDES A TELEVISION TRANSMISSION

The national television circuits should be so adjusted that, when they are connected to the international television link, the amplitude of the video signals at the video interconnection points is in accordance with Recommendation N.60.

Recommendation N.62

TESTS TO BE MADE DURING THE LINE-UP PERIOD THAT PRECEDES A TELEVISION TRANSMISSION

PART 1 — GENERAL

Tests during the line-up period are carried out by the telecommunication Administrations.

In principle, they comprise tests (with correcting adjustments if necessary) using special test signals for the different parameters tested. It is assumed that the individual circuit sections will be regularly maintained in accordance with the appropriate N Series Recommendations or, in the case of a section via a communications satellite, by the appropriate authority.

The tests to be carried out during the line-up period are given in the following Tables for 525-line and 625-line standards [1]. These tables give the details of tests for colour transmission purposes. The individual test signals specified are full frame signals defined by the C.C.I.R. except as below [2].

PART 2 — TEST LIMITS FOR INTERNATIONAL CIRCUITS

In Tables 1 and 2:

a) The test values given are target maintenance values for international circuits tested between I.T.C.s and formed by the occasional connection of permanent circuit sections. No values are given for permanent circuits because these are subject to bilateral agreements.

b) " X " signifies that the test concerned should be made on a routine basis. " 0 " signifies that the test concerned is not foreseen as a routine test but that it may be performed for confirmation when necessary.

c) All the video waveform tests described below should be made at normal level (see Recommendation N.60).

d) The test periodicities given in Table 2 are the minimum values considered suitable. These periodicities may be varied if conditions warrant.

[1] In the absence of intermediate standards converters.

[2] In some cases, the test signals mentioned have so far been specified by the C.C.I.R. only as insertion test signals.

e) The test signals recommended are full-frame signals. In case of trouble, good use may be made of insertion test signals when available from the broadcasting organization.

f) The test values for I.T.C.-I.T.C. (terrestrial + satellite) circuits were derived from a summation (where appropriate, by laws of addition given in C.C.I.R. Recommendations 421-2 and 451-1) of the I.T.C.-I.T.C. terrestrial circuit figures (given in Tables 1 and 2) and the earth station-to-earth station (INTELSAT IV) parameters given in Tables A and B of Annex 1 to this Recommendation for 525-line and 625-line systems respectively.

g) For details of the equivalent dB values of the IRE divisions mentioned in the tables, see Table 1 in the Appendix to this Recommendation.

Notes to Table 1

1. See C.C.I.R. Recommendation 421-2, New Delhi, 1970, for definition.
2. See C.C.I.R. Recommendation 451-1, New Delhi, 1970, for definition.
3. The test limits are indicated as a guide for critical observation during video transmissions.
4. This objective should be relaxed in accordance with Table 2 in the Appendix to this Recommendation when one of the earth stations is separated from its I.T.C. by more than 2500 kilometres.
5. These objectives should be relaxed in accordance with Table 2 in the Appendix to this Recommendation when the terrestrial facilities exceed 2500 kilometres.
7. If test time is short, a test of 50% APL is sufficient with suitable notation of the results. Poor results at normal level may indicate the need to make additional tests over the dynamic range of 10% to 90% APL. These additional tests should be carried out during trouble-shooting procedures on the indicated circuit section(s).
8. The variation in amplitude of the top of the bar (window) signal, relative to its mid-point amplitude, should not exceed the values indicated. In the case of field-time distortion, the first and last 250 microseconds of the bar top should be ignored. For line-time distortion the first and last 1 microsecond should be ignored.
9. The requirement for impulsive noise shall be equal to or less than one impulse per minute of a sporadic or infrequently-occurring nature.
10. This item is under study for future use.
11. Test waveform as shown in Figure 1 of the Appendix to this Recommendation to be used for this item.
12. Test waveform to be used for this test is shown in Figure 2 of the Appendix to this Recommendation. The composite pulse will fall somewhere between 10 T and 20 T. The exact pulse width is still under study.
13. The bar portion of the test waveform is used for this test.
14. For this test, the 2 T sine-squared pulse is added in position " A " of the waveform.
15. The test waveform of the five-riser staircase with a superimposed sub-carrier of 3.58 MHz at 40 IRE divisions amplitude is shown in Figure 3 of the Appendix to this Recommendation. An alternative test waveform for this test is the ten-riser staircase with a superimposed sub-carrier of 3.58 MHz at 20 IRE divisions amplitude as shown in Figure 4 of the Appendix to this Recommendation.
16. The frequency response within the passband of the circuit should not fall outside the tolerances given, relative to the nominal values.
17. The C.C.I.R. expresses the limit, in this way, as ± X. The C.C.I.T.T. has copied this, but is of the opinion that for an expression of this nature it would be better to put the sign for " is equal to or less than ".
18. Values using the noise weighting network for System M (Canada and U.S.A.). See C.C.I.R. Recommendation 421-2 in C.C.I.R. Volume V, part 2, page 189.

TABLE 1

525-LINE STANDARD

Item	Parameter	Test waveform	I.T.C. to I.T.C. tests for circuits having terrestrial sections only (cable and/or radio)		I.T.C. to I.T.C. tests for circuits having terrestrial sections (cable and/or radio) and a satellite section	
			Testing during line-up period	Test values	Testing during line-up period	Test values
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Insertion gain Note 1	No. 2 or equivalent Notes 1, 13	X	±1 dB 100 ± 11 IRE divisions	X	±1 dB 100 ± 11 IRE divisions
2a	Variation of insertion gain (short period, e.g. 1 sec.) Note 1	No. 2 or equivalent Notes 1, 13	X	±0.3 dB 100 ± 3 IRE divisions	X	±0.4 dB or 100 ± 4 IRE divisions
2b	Variation of insertion gain (medium period, e.g. 1 hour) Notes 1, 3, 13	No. 2 or equivalent Notes 1, 13	0	±1 dB 100 ± 11 IRE divisions	0	±1 dB 100 ± 11 IRE divisions
3	Signal to continuous random noise ratio (weighted) Notes 1, 18	No input signal	X	Better than 56 dB Note 5	X	Better than 50 dB Note 4
4a	Signal to periodic noise ratio—power supply hum—0-1 kHz Note 2	No input signal	0	Better than 50 dB after clamp 35 dB unclamped	0	Better than 47 dB after clamp 32 dB unclamped
4b	Signal to periodic noise ratio—1 kHz to 4.2 MHz Note 2	No input signal	0	Better than 55 dB	0	Better than 52 dB
5	Signal to impulsive noise ratio Notes 2, 9	No input signal	0	Better than 25 dB	0	
6	Luminance non-linearity Notes 1, 2	5-riser staircase or No. 3	0	3%	0	6%
7	Chrominance non-linearity Note 10					
8a	Luminance-chrominance intermodulation differential gain Note 2	5-riser staircase Note 15	X Note 7	±1 dB or ±10% (Note 17)	X Note 7	±1.5 dB or ±15% (Note 17)

TABLE 1 *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
8b*	Luminance-chrominance intermodulation differential phase Note 2	5-riser staircase Note 15	X Note 7	±3.0° (Note 17)	X Note 7	±6.0° (Note 17)
9	Chrominance-luminance intermodulation Note 10					
10	Non-linear distortion synchronizing signal Note 2	5-riser staircase Note 15	0	±10% (40 ± 4 IRE divisions)	0	±10% (40 ± 4 IRE divisions)
11a*	Linear waveform distortion—field time Note 1	No. 1 or equivalent Note 1	As required	±2% Note 8	As required	±4% Note 8
11b*	Linear waveform distortion—line time Note 1	No. 2 or equivalent Note 1	X	±1% Note 8	X	±2% Note 8
11c	Linear waveform distortion—short time (overshoot) Note 1	No. 2 or equivalent Notes 1, 14	X	1st adjacent lobe ⩽6% 2nd adjacent lobe ⩽3%	X	1st adjacent lobe ⩽10% 2nd adjacent lobe ⩽5%
11d	Linear waveform distortion—short time (2 T pulse to bar ratio)	No. 2 or equivalent Notes 1, 14	X	0.94 to 1.06	X	0.88 to 1.12
12	Steady state attenuation—frequency characteristic	Multiburst Notes 11, 16	X	+1 dB to −0.7 dB	X	+2 dB to −1 dB
13a	Chrominance-luminance gain inequality Note 2	Composite sine² pulse Note 12	X	+8% to −11%	X	+12% to −20%
13b	Chrominance-luminance delay inequality Note 2	Composite sine² pulse Note 12	X	±80 nanoseconds	X	±100 nanoseconds

* For this provisional recommendation, the values specified for parameters 8b, 11a and 11b in columns 5 and 7 might not be met by some Administrations.

TABLE 2

625-LINE STANDARD

Item	Parameter	Test waveform	I.T.C.-to-I.T.C. tests for circuits having terrestrial (cable and/or radio) sections only					I.T.C.-to-I.T.C. tests for circuits having terrestrial sections (cable and/or radio) and a satellite section	
			Occasional circuits		Permanent circuits			Occasional circuits	
			Testing during line-up period	Test values	Setting up test	Periodical test	Periodicity	Testing during line-up period	Test values
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Insertion gain	Test signal No. 2 Note 1	X	0 dB ±1 dB	X	X	Daily	X	0 dB ±1 dB
2a	Variation of insertion gain, short period (e.g. 1 sec.)	Test signal No. 2 Note 1	X	±0.2 dB	X			X	±0.3 dB
2b	Variation of insertion gain, medium period (e.g. 1 hour)	Test signal No. 2 Note 1	0	±1 dB Note 15				0	±1 dB Note 15
3	Signal-to-continuous random noise ratio (C.C.I.R. Recs. 421, 451)	No input signal Note 3	X	Better than 55 dB Note 2	X	X	Weekly	X	Better than 50 dB Note 2
4a	Signal-to-periodic noise ratio, power supply hum 0-1 kHz Note 4	No input signal	0	Better than 35 dB	X	X	Weekly		Better than 35 dB
4b	Signal-to-periodic noise ratio, 1 kHz-*fc* (*fc* top freq. of TV system) Note 4	No input signal	0	Better than 52 dB	X				Better than 52 dB
5	Signal-to-impulsive noise ratio Note 4	No input signal	0	Better than 25 dB	X				Better than 25 dB
6	Luminance non-linearity (normal level)	5-riser staircase Note 5		⩽12%	X	X	Monthly		

TABLE 2 *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
7	Chrominance non-linearity Note 6	FF/G2			X	X	Infrequent		
8a	Luminance-chrominance intermodulation, differential gain	As in C.C.I.R. Rec. 451-1 or 421-2	X	±8%	X	X	Monthly	X	±15%
8b	Luminance-chrominance intermodulation, differential phase	No. 3a and 3b Note 7	X	±5°	X	X	Monthly	X	±8°
9	Chrominance-luminance intermodulation Note 8	Note 8			X	X	Infrequent		
10	Non-linear distortion synchronizing signal Note 9	Note 9	0	±10%	X	X	Monthly		+12% −15%
11a	Linear waveform distortion, field time Note 11	Note 10	0	±6% Note 10	X	X	Monthly		±6% Note 10
11b	Linear waveform distortion, line time	Note 10	X	±3% Note 10	X	X	Monthly	X	±4% Note 10
11c	Linear wavefrom distortion, short time (step response) Note 12	Note 12	X		X	X	Monthly	X	
11d	Linear waveform distortion, short time (2 T pulse-to-bar ratio)	Note 16	0	0.92 to 1.08	X	X	Monthly	X	0.90 to 1.10
12	Steady state attenuation-frequency characteristic Note 13	Note 13	X	+1.5 dB to −1.0 dB	X	X	Monthly	X	+2.0 dB to −1.5 dB
13a	Chrominance-luminance gain inequality	Note 14	X	±10%	X	X	Daily	X	±15%
13b	Chrominance-luminance delay inequality	Note 14	X	±100 ns	X	X	Daily	X	±150 ns

Notes to Table 2

1. T.S. No. 2—test signal number 2 as described in C.C.I.R. Recommendation 421-2 (New Delhi, 1970). Other bar signals may be used by bilateral agreement.

2. The figures given assume the use of the 625-line weighting network for systems D,K,L, described in C.C.I.R. Recommendation 421-2 (New Delhi, 1970).

3. There are several methods of measuring noise in the presence of video signals which may be employed by bilateral agreement between the Administrations concerned.

4. For further details on these noise parameters refer to C.C.I.R. Recommendations 421-2, 451-1 (New Delhi, 1970).

5. The test signal should be a five-riser staircase as described in C.C.I.R. Recommendation 451-1, Annex to Part 2, Figure 3.

6. This test will be performed on permanent circuits only subject to the availability of test signal G2 (C.C.I.R. Recommendation 473, New Delhi, 1970) as a full-frame signal.

7. The test signals are those described in C.C.I.R. Recommendation 451-1 (5-riser staircase with APL range of 12.5 to 87.5%) or, alternatively, test signals 3*a* and 3*b* described in C.C.I.R. Recommendation 421-2 (New Delhi, 1970).
   If test time is short, a test at 50% APL is sufficient with suitable notation on the results. In addition, tests of the overload characteristics (+3 dB reference 1 volt) may be indicated by poor results at normal level. These should be carried out during trouble-shooting procedures on the indicated circuit section(s). The test limits apply to a normal level only.

8. This test will be performed on permanent circuits only, subject to the availability of a suitable test signal. Test signal G2 (C.C.I.R. Recommendation 473, New Delhi, 1970) is considered suitable if available in full-frame form.

9. The signal described in Note 5 may be used for this test. Records of this parameter may be considered optional according to the Administrations' wishes on pre-transmission tests.

10. The test signals defined in C.C.I.R. Recommendations 421-1 or 451-1 should be used. The variation in amplitude of the top of the bar (window) signal, relative to its mid-point amplitude, should not exceed the values indicated. In the case of field-time distortion, the first and last 250 microseconds of the bar top should be ignored. For line-time distortion, the first and last 1 microsecond should be ignored.

11. This parameter is not necessarily measured on pre-transmission tests but may be recorded when a signal combining several functions (window or electronic test-pattern) is available from the broadcasting organization.

12. No limits have been given for this parameter in view of the differing methods of measurements in use in a) North America, b) the United Kingdom, and c) the rest of Europe. These are respectively:
    a) the amplitude of the 1st and 2nd adjacent lobes following a 2 T pulse,
    b) " k " rating of a 2 T pulse,
    c) the amplitude of overshoots of a 1 T or 2 T rise time bar.

13. The test signal should be a full frame version of C3 and C1 or C2 given in C.C.I.R. Recommendation 473 (New Delhi, 1970). This test was considered by the Group as a desirable *option* to be used as required by certain Administrations in place of transient tests. The frequency response within the passband of the circuit should not fall outside the tolerances given, relative to the nominal value.

14. The test signal should be that shown in Figure 5 of C.C.I.R. Recommendation 451-1 (but with the pulse having a half amplitude duration of 20 T) or the composite signal shown in C.C.I.R. Recommendation 473, line 17, as a full-frame test signal.

15. The test limits are indicated as a guide for critical observations during video transmissions.

16. Test signal No. 2 (C.C.I.R. Recommendation 421-2) with a 2 T sine-squared pulse added in position "A " of the waveform.

ANNEX 1
(to Recommendation N.62)

Provisional test values for 525-line and 625-line satellite circuit-sections and 525-line terrestrial circuit-sections developed from information provided by A. T. & T. and COMSAT

TABLE A

525-LINE STANDARD

Item	Parameter	Test waveform	International satellite circuit-section					Terminal I.T.C. to adjacent earth station circuit section
			Setting up test	Test[a] values	Testing during line-up period	Test[a] values	Notes (see the following list)	Test values 0 dB
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Insertion gain	T.S. No. 2	X	0 dB ± 0.25 dB 0 dB ± 0.25 dB	X	0 dB ± 0.25 dB 0 dB ± 0.25 dB	1, 2	±0.5 dB or 100 ± 5 IRE divisions
2a	Variations insertion gain—short period (e.g. 1 sec.)	T.S. No. 2	X	±0.1 dB ±0.1 dB	X	±0.1 dB ±0.1 dB	1, 2	±0.3 dB or 100 ± 3 IRE divisions
2b	Variations insertion gain—medium period (e.g. 1 hour)	T.S. No. 2	X	±0.25 dB ±0.25 dB		±0.25 dB ±0.25 dB	1, 2	±0.5 dB or 100 ± 5 IRE divisions
3	Signal to continuous random noise ratio	No input signal	X	54 dB 50 dB	X	54 dB 50 dB	3, 4	56 dB (see Note 4 to Table 1)
4a	Signal to periodic noise ratio power supply hum (0 to 1 kHz)	No input signal	X	50 dB 49 dB	0	50 dB 49 dB	5	50 dB after clamp 35 dB unclamped
4b	Signal to periodic noise ratio (1 kHz to f_c) (f_c = max. frequency of the TV system)	No input signal	X	55 dB 55 dB	0	55 dB 55 dB	6	55 dB

[a] The values shown on the upper line are for INTELSAT IV, and the values shown on the lower line are for INTELSAT III, satellite circuit-sections.

TABLE A *(cont.)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
5	Signal to impulsive noise ratio	No input signal	X	25 dB / 25 dB	0	25 dB / 25 dB		25 dB
6	Luminance non-linearity	5-riser staircase or T.S. No. 3	X	Not yet specified / Not specified		Not yet specified / Not specified	7	3%
7	Chrominance non-linearity	Not yet specified		Not yet specified / Not specified		Not yet specified / Not specified		Not yet specified
8a	Luminance-chrominance intermodulation (differential gain)	5-riser staircase	X	±10% / ±10%	X	±10% / ±10%	7, 8, 9	±10%
8b	Luminance-chrominance intermodulation (differential phase)	5-riser staircase	X	±3° / ±5°	X	±3° / ±5°	7, 8, 9	±3.0°
9	Chrominance-luminance intermodulation	Not yet specified		Not yet specified / Not specified		Not yet specified / Not specified		Not yet specified
10	Non-linear distortion synchronizing signal	5-riser staircase	X	+ 5% −10% / + 5% −10%	0	+ 5% −10% / + 5% −10%	7, 8, 9	±10% or (40 ± 4 IRE divisions)
11a	Linear waveform distortion—field time	T.S. No. 1	X	±1% / ±2%	0	±1% / ±2%	1	±2.0% (See Note 8 to Table 1)

TABLE A *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
11b	Linear waveform distortion—line time	T.S. No. 2	X	±1% / ±1.5%	X	±1% / ±1.5%	1, 2	±1.0% (See Note 8 to Table 1)
11c	Linear waveform distortion—short time (step response)	T.S. No. 2	X	Not yet specified / Not specified		Not specified / Not specified	1, 10	1st adjacent lobe ⩽6% 2nd adjacent lobe ⩽3.0%
11d	Linear waveform distortion—short time (2 T P/B ratio)	T.S. No. 2	X	1.04 to 0.96 / 1.06 to 0.94	X	1.04 to 0.96 / 1.06 to 0.94	1, 11	0.94 to 1.06
12	Steady state response attenuation-frequency characteristic	Multi-burst	X	+1 dB to −0.5 dB / +1 dB to −0.5 dB	0	+1 dB to −0.5 dB / +1 dB to −0.5 dB	12, 14	+1 dB to −0.7 dB
13a	Chrominance-luminance gain inequality	Composite sine² pulse	X	±10% / Not specified	X	±10% / Not specified	13	+9% to −11%
13b	Chrominance-luminance delay inequality	Composite sine² pulse	X	±50 ns / Not specified	X	±50 ns / Not specified	13	±80 ns

TABLE B

625-LINE STANDARD

Item	Parameter	Test waveform	International satellite circuit section				
			Setting up test	Test[a] values	Testing during line-up period	Test[a] values	Notes (see the following list)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Insertion gain	T.S. No. 2	X	0 dB ± 0.25 dB 0 dB ± 0.25 dB	X	0 dB ± 0.25 dB 0 dB ± 0.25 dB	1
2a	Variations insertion gain—short period (e.g. 1 sec.)	T.S. No. 2	X	±0.1 dB ±0.1 dB	X	±0.1 dB ±0.1 dB	1
2b	Variations insertion gain—medium period (e.g. 1 hour)	T.S. No. 2	X	±0.25 dB ±0.25 dB		±0.25 dB ±0.25 dB	1
3	Signal-to-continuous random noise ratio	No input signal	X	54 dB 52 dB	X	54 dB 52 dB	3, 4
4a	Signal-to-periodic noise ratio power supply hum (0-1kHz)	No input signal	X	50 dB after clamp 49 dB after clamp	0	50 dB after clamp 49 dB after clamp	5
4b	Signal-to-periodic noise ratio (1 kHz $- f_c$)	No input signal	X	55 dB 55 dB	0	55 dB 55 dB	6

[a] The values shown on the upper line are for INTELSAT IV and the values shown on the lower line are for INTELSAT III, satellite circuit-sections.

TABLE B *(cont.)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
5	Signal-to-impulsive noise ratio	No input signal	X	25 dB / 25 dB	0	25 dB / 25 dB	
6	Luminance non-linearity	5-riser staircase	X	Not yet specified / Not specified		Not yet specified / Not specified	7
7	Chrominance non-linearity	Full field G2	X	Not yet specified / Not specified		Not yet specified / Not specified	8
8a	Luminance-chrominance intermodulation (differential gain)	5-riser staircase	X	±10% / ±10%	X	±10% / ±10%	7
8b	Luminance-chrominance intermodulation (differential phase)	5-riser staircase	X	±3° / ±5°	X	±3° / ±5°	7
9	Chrominance-luminance intermodulation	Full field G2	X	Not yet specified / Not specified		Not yet specified / Not specified	8
10	Non-linear distortion synchronizing signal	5-riser staircase	X	+ 5% − 10% / + 5% − 10%		+ 5% − 10% / + 5% − 10%	7
11a	Linear waveform distortion—field time	T.S. No. 1	X	±1% / ±2%		±1% / ±2%	1

TABLE B *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
11b	Linear waveform distortion—line time	T.S. No. 2	X	±1% / ±1.5%	X	±1% / ±1.5%	1
11c	Linear waveform distortion—(short time step response)	T.S. No. 2	X	Not yet specified / Not specified		Not yet specified / Not specified	1, 9
11d	Linear waveform distortion—short time (2 T P/B ratio)	T.S. No. 2	X	1.04 to 0.96 / 1.06 to 0.94	X	1.04 to 0.96 / 1.06 to 0.94	1, 2
12	Steady state attenuation frequency characteristic	Full field G3	X	+1.0 dB to −0.5 dB Note 10 / +1.0 dB to −0.5 dB Note 10	X	+1.0 dB to −0.5 dB Note 10 / +1.0 dB to −0.5 dB Note 10	6, 8
13a	Chrominance-luminance gain inequality	Full field F	X	±10% / Not specified	X	±10% / Not specified	8
13b	Chrominance-luminance delay inequality	Full field F	X	±50 ns / Not specified	X	±50 ns / Not specified	8

Notes to Table A

525-LINE SATELLITE CIRCUIT-SECTIONS AND TERRESTRIAL CIRCUIT-SECTIONS

1. This test signal is described in C.C.I.R. Recommendation 421-2.
2. While T.S. No. 2 is preferred, other line bar signals can be used for this test.
3. Noise weighting per C.C.I.R. Recommendation 421-2, system M (U.S.A. and Canada) is used in this test.
4. There are several methods for measuring noise in the presence of video signals which may be employed by bilateral agreement between the Administrations concerned.
5. This parameter is measured after clamping to ensure the removal of the low-frequency energy dispersal signal.
6. For a 525-line satellite circuit section $f_c = 4.2$ MHz.
7. This test, while not specified as yet, would be similar to that shown in C.C.I.R. Recommendation 451-1 for the 625-line systems.
8. For this test the 5-riser staircase signal should be switchable through the range 10 to 90% APL.
9. The ramp or 10-riser staircase signal may be used in this test.
10. Test limits for this parameter must await agreement on the step rise time.
11. A sine-squared pulse of half-amplitude duration HAD = 250 nanoseconds is inserted on T.S. No. 2 for this test.
12. Details of the multiburst test signal for the 525-line system have not as yet been agreed upon. It is expected, however, that it will contain a reference white flag, followed by six frequency bursts of 0.5 MHz, 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.6 MHz and 4.2 MHz. These bursts would have a maximum peak-to-peak amplitude of 0.42 volts and would be centred on a mid-grey pedestal.
13. Details of the composite pulse have not been agreed upon as yet. However, it is expected that it will have a half-amplitude duration of between 10 T and 20 T. The exact pulse width is still under study.
14. The frequency response within the passband of the circuit should not fall outside the tolerances given relative to the nominal value.

Notes to Table B

625-LINE SATELLITE CIRCUIT-SECTIONS

1. This test signal is described in C.C.I.R. Recommendation 421-2.
2. A sine-squared pulse of half-amplitude duration HAD = 200 nanoseconds is inserted on T.S. No. 2 for this test.
3. Noise weighting per C.C.I.R. Recommendation 421-2, systems D, K and L is used in this test.
4. There are several methods for measuring noise in the presence of video signals which may be employed by bilateral agreement between the Administrations concerned.
5. This parameter is measured after clamping to ensure the removal of the low-frequency energy dispersal signal.
6. For a 625-line satellite circuit section, $f_c = 6$ MHz.
7. The five-riser staircase waveform is described in C.C.I.R. Recommendation 451-1.
8. This test waveform is described in C.C.I.R. Recommendation 473. If it is available on a full frame basis, it should be so used for this test.
9. Test values for this parameter must await agreement on the step rise-time.
10. The frequency response within the passband of the circuit should not fall outside the tolerances given relative to the nominal value.

APPENDIX
(to Recommendation N.62)

TABLE 1

CONVERSION FOR VIDEO TEST SIGNALS

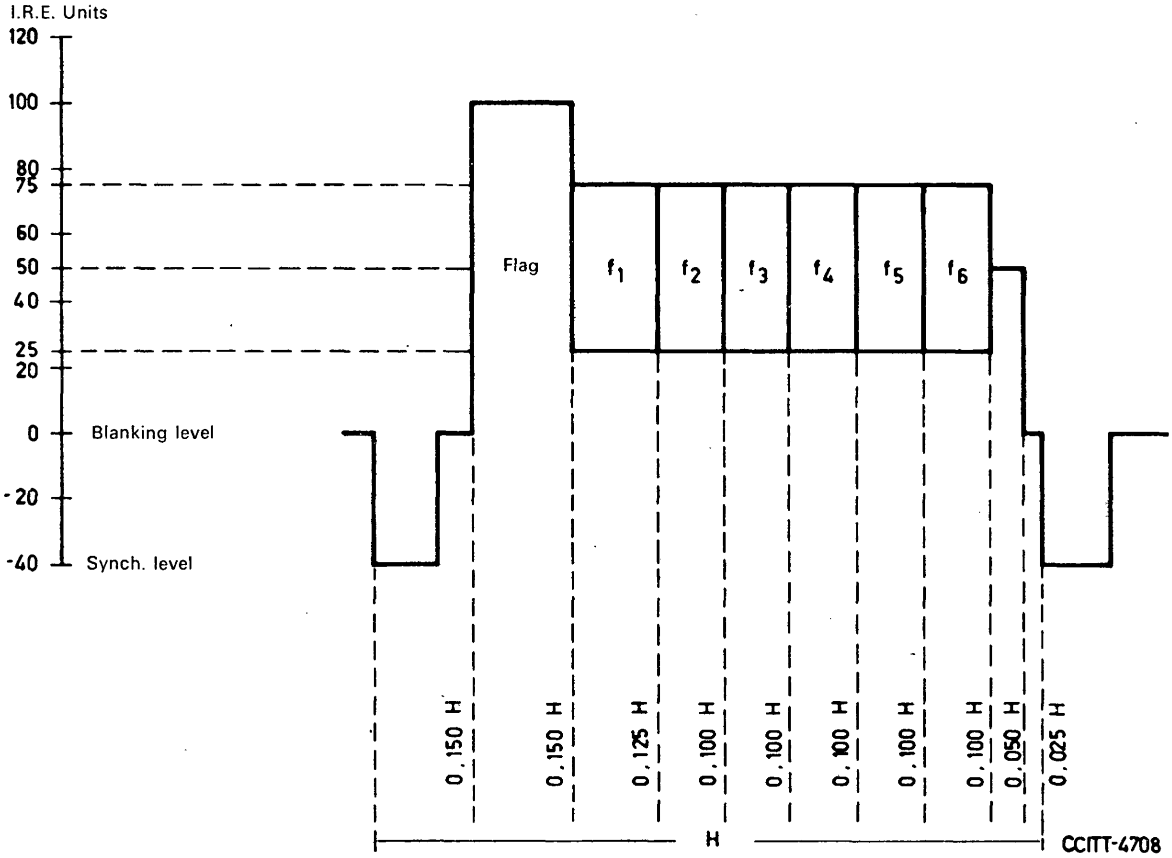
Loss conversion scale			*Gain conversion scale*		
Volt	*I.R.E. Units*	*dB*	*Volt*	*I.R.E. Units*	*dB*
0.7	100	0.0	0.7	100	0.0
0.69	99	0.1	0.71	101	0.1
0.69	98	0.2	0.72	102	0.2
0.68	97	0.3	0.73	103	0.3
0.67	96	0.4	0.73	104	0.3
0.67	95	0.4	0.74	105	0.4
0.66	94	0.5	0.75	106	0.5
0.65	93	0.6	0.76	107	0.6
0.64	92	0.7	0.76	108	0.7
0.64	91	0.8	0.77	109	0.7
0.63	90	0.9	0.78	110	0.8
0.62	89	1.0	0.78	111	0.9
0.62	88	1.1	0.79	112	1.0
0.61	87	1.2	0.8	113	1.1
0.6	86	1.3	0.8	114	1.1
0.6	85	1.4	0.81	115	1.2
0.59	84	1.5	0.82	116	1.3
0.58	83	1.6	0.83	117	1.4
0.57	82	1.7	0.83	118	1.4
0.57	81	1.8	0.84	119	1.5
0.56	80	1.9	0.85	120	1.6
0.53	75	2.5	0.88	125	1.7
0.49	70	3.1	0.92	130	2.3
0.46	65	3.7	0.95	135	2.6
0.42	60	4.4	0.99	140	2.9
0.39	55	5.2	1.02	145	3.2
0.35	50	6.0	1.06	150	3.5
			1.41	200	6.0

TABLE 2

CONTINUOUS RANDOM NOISE (WEIGHTED) FOR 525-LINE SYSTEMS

Objectives for signal-to-noise ratios on circuits with a terrrestrial circuit section component exceeding 2500 kilometres in length

Terrestrial distance (km)	Terrestrial circuits S/N ratio (dB)	Terrestrial plus satellite circuits S/N ratio (dB)
3500	54.6	49.5
4500	53.4	48.5
5500	52.6	48.0
6500	51.8	47.5



Signal characteristics	H	Burst frequencies in MHz					
		f_1	f_2	f_3	f_4	f_5	f_6
525-line	63.5 μs	0.5	1.5	2.0	3.0	3.6	4.2

FIGURE 1/N.62. — **525-line multiburst signal.**

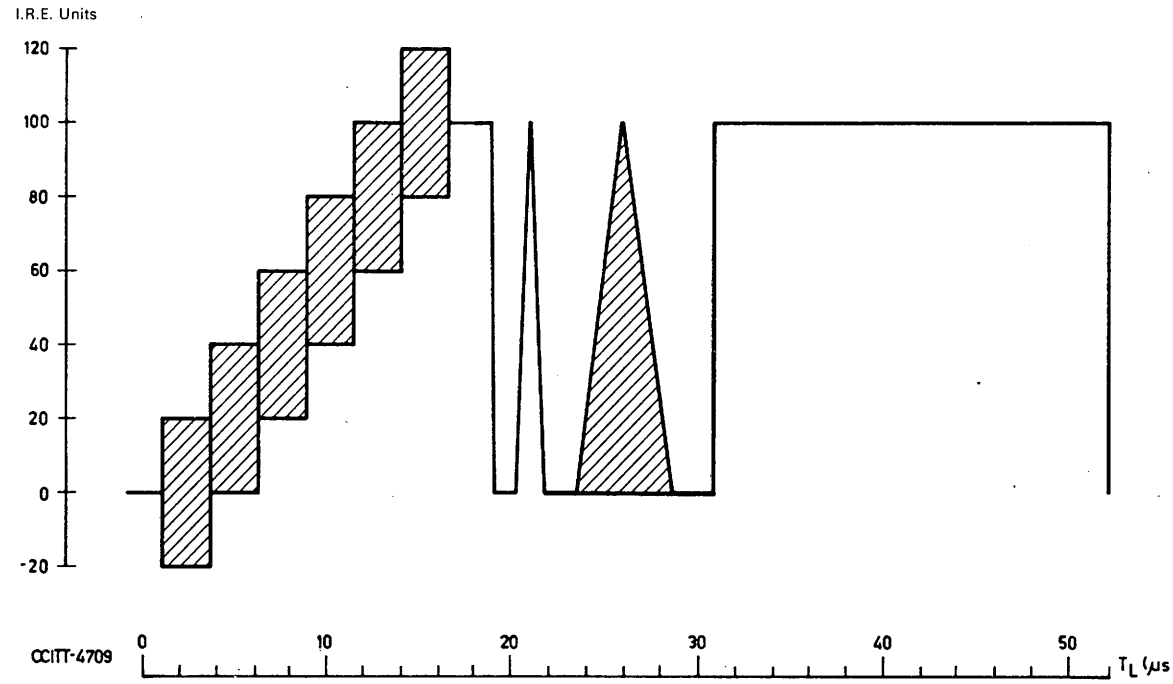
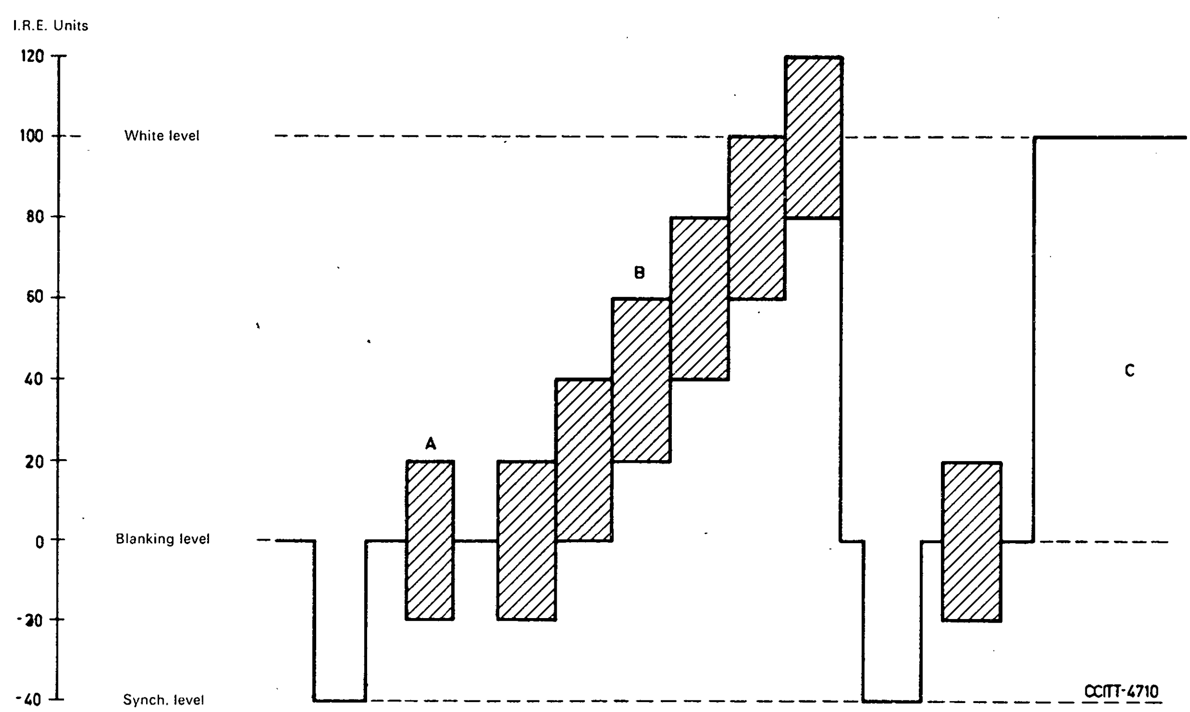
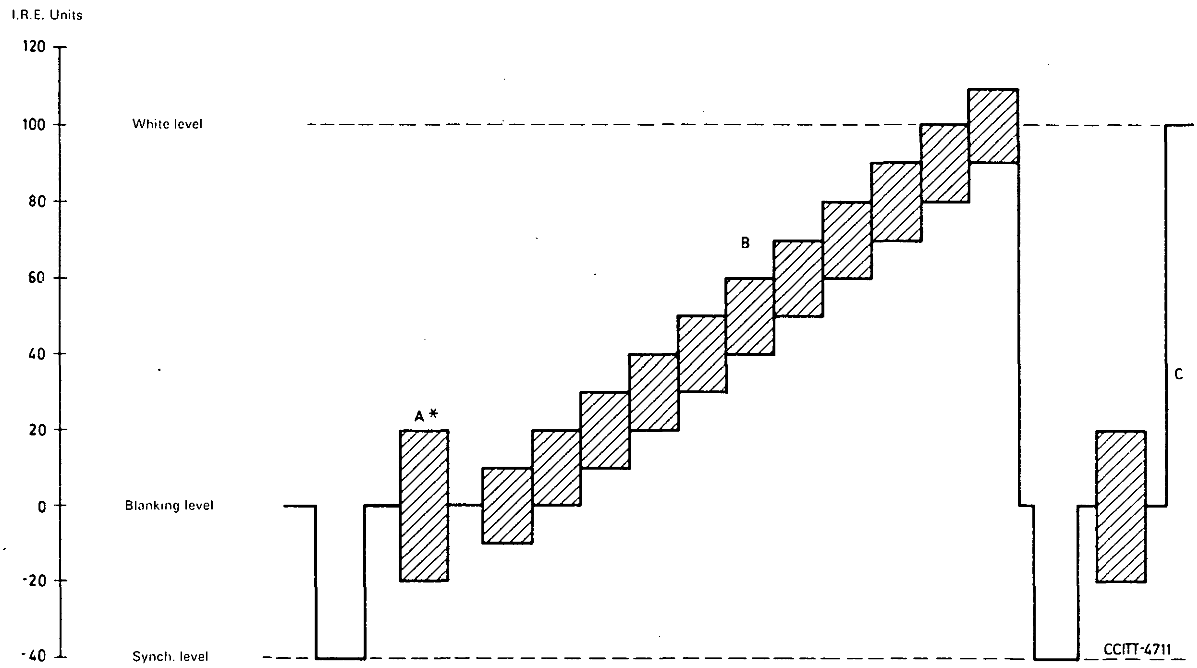


FIGURE 2/N.62. — **525-line combined single-line test signal with composite pulse (specific component signal spacing under study)**



A = Colour reference burst (3.58 MHz) 40 I.R.E. units
B = Superimposed sub-carrier (3.58 MHz) 40 I.R.E. units
C = Three intermediate lines with switchable white level or blanking level

FIGURE 3/N.62. — **525-line 5-riser staircase test signal.**



A = Colour reference (3.58 MHz) 40 I.R.E. units
B = Superimposed sub-carrier (3.58 MHz) 20 I.R.E. units
C = Four intermediate lines with switchable white level or blanking level
* On some generators, the amplitude of the reference burst may only be 20 I.R.E. units peak-to-peak

FIGURE 4/N.62. — **10-riser staircase test signal (525 lines).**

Recommendation N.63

TEST SIGNALS TO BE USED BY THE BROADCASTING ORGANIZATIONS DURING THE PREPARATORY PERIOD

After the broadcasting organizations have taken over the international television connection, they may decide to make measurements on the complete connection from the point where the television programme is produced to the point or points where it is to be received.

The broadcasting organizations often use live pictures for testing during the preparatory period, especially when a standards convertor is involved. If for any reason they should need to send test signals then it is desirable that the telecommunication Administrations should recommend the broadcasting organizations in their countries to send signals that are in accordance with those recommended in Recommendation N.62 (at levels in accordance with Recommendation N.60), so that the staff at intermediate video interconnection points can, if necessary, compare the results of the measurements made by the broadcasting organizations with those obtained by the telecommunication Administrations during the line-up period. There is no occasion to readjust the output levels of the station equipment since these have already been set during the line-up period.

Recommendation N.64

QUALITY ASSESSMENT

(Provisional text)

5-grade scale for quality assessment

The following 5-grade scale, applicable to both quality and impairment assessments of pictures, is provisionally proposed:

Grade	*Quality*	*Impairment*
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Evident; slightly annoying
2	Poor	Annoying but usable
1	Bad	So annoying as to be not normally usable.

Although the impairment scale is intended, in this present context, to apply to overall picture assessment, it should be noted that the same scale could be used for a critical assessment of particular picture characteristics. Moreover, the number of the grade can be taken as either a quality assessment *or* an impairment assessment, depending on the context, for example, a Grade 3 picture is of " fair " quality, having " evident, slightly annoying " impairments.

Recommendation N.67

MONITORING TELEVISION TRANSMISSIONS. USE OF THE FIELD BLANKING INTERVAL

1. *Monitoring points*

Technical control by the telecommunication Administrations of a television transmission in progress should be possible at any time:

— at national and international television centres in the connection;

— at the last staffed-station immediately preceding the frontier of each country and at a point in the station which will include as much as possible of the station equipment in the direction of transmission concerned (by providing monitoring-demodulators if necessary).

These centres and stations should be equipped with an oscilloscope (the horizontal sweep frequency of which is synchronized to the line frequency) for monitoring the electrical signal and a picture-monitor for monitoring the complete picture.

2. *Numbering of lines in a television field*

For 625-line systems the numbering of the lines is as follows: Line 1 starts at the instant indicated by 0_v in Figure 1*a* of Table III A of C.C.I.R. Report 308-2 [1]; at this instant, the leading edge of the line synchronization pulse coincides with the beginning of the sequence of field synchronization pulses. The lines are numbered according to their sequence in time, so that the first field comprises lines 1 to 312 as well as the first half of line 313, whereas the second field comprises the second half of line 313 and lines 314 to 625.

For 525-line systems the numbering of the lines is as follows:

Line 1 of field 1 is the line starting with the first equalizing pulse at the instant indicated by 0_{E1} in Figure 3*a* of Table III C of C.C.I.R. Report 308-2 [2]; line 1 of field 2 is the line starting with the second equalizing pulse at one half-line period after the instant indicated by 0_{E2} in Figure 3*b* of Table III C of C.C.I.R. Report 308-2 [2].

3. *625-line insertion test signals* (I.T.S.)

3.1 *Monochrome only*

The C.C.I.R. has recommended a special signal which may be inserted by broadcasting organizations in the field blanking interval of a 625-line television signal [3]. The signal is illustrated in Figure 1/N.67 and is made up of a 10 μs white bar (B_2) a 2 T sine-squared pulse (B_1) and a 5-riser staircase (D_1).

A detailed description of this signal is given in C.C.I.R. Recommendation 420-2 (C.C.I.R. XIIth Plenary Assembly, New Delhi, 1970, Volume V, Part 2, page 237).

This signal should be inserted on lines 17 and 330 for international transmission.

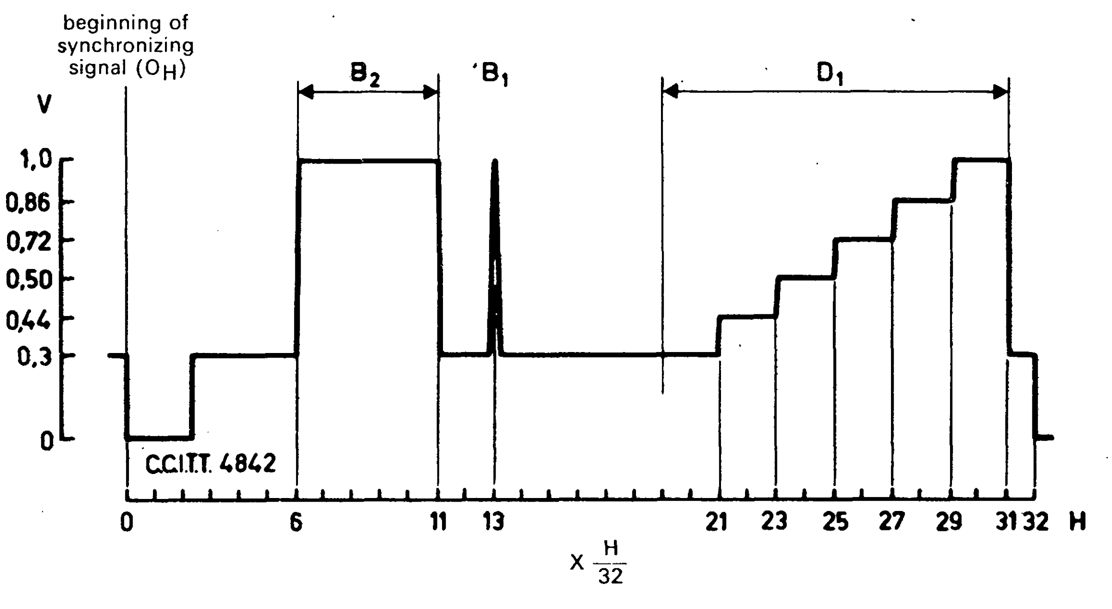


FIGURE 1/N.67. — **Test signal for insertion in field-blanking interval of a 625-line monochrome television signal (C.C.I.R. Recommendation 420-2).**

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[1] C.C.I.R. XIIth Plenary Assembly, New Delhi, 1970, Volume V of the C.C.I.R., Part 2, page 28.

[2] C.C.I.R. XIIth Plenary Assembly, New Delhi, 1970, Volume V of the C.C.I.R., Part 2, page 30.

[3] In practice this signal would normally only be added by an organization operating an exclusively monochrome television service.

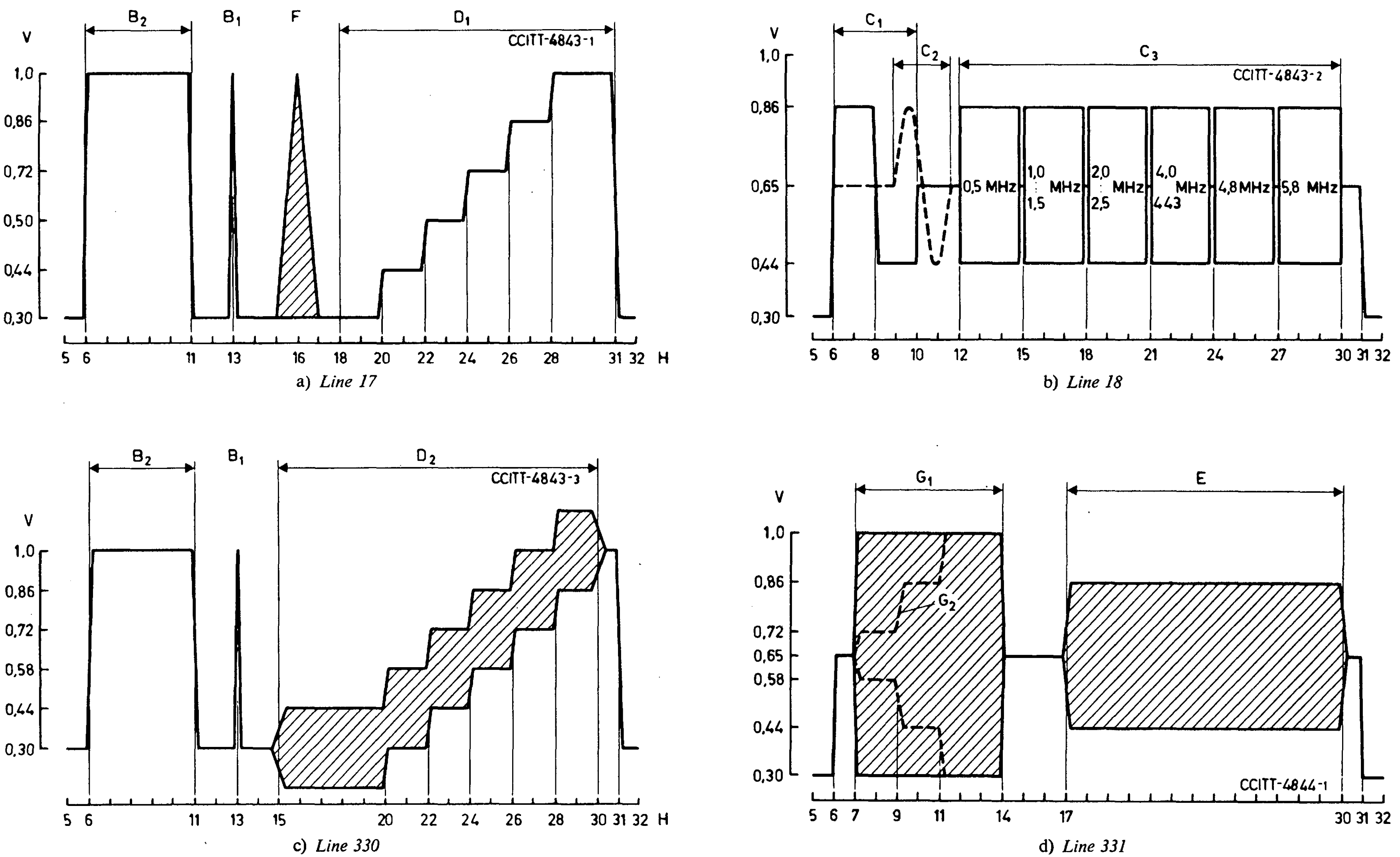

FIGURE 2/N.67. — **Test signal for insertion in field blanking intervals of a 625-line colour (or monochrome) television signa (C.C.I.R. Recommendation 473).**

A detailed description of these signals is given in C.C.I.R. Recommendation 473 (C.C.I.R. XIIth Plenary Assembly, New Delhi, 1970, Volume V, Part 2, page 239).

3.2 *Colour or monochrome*

The advent of colour has caused the C.C.I.R. to recommend a more comprehensive set of test signals which may be inserted on lines 17, 18, 330 and 331 for international monochrome or colour transmissions [1]. This signal is illustrated in Figure 2/N.67 [2] and is made up as follows:

c) *Line 17*

A 10 μs white bar (B_2), a 2 T sine-squared pulse (B_1), a 20 T composite pulse (F) and a 5-riser staircase (D_1).

Line 18

A multiburst (C_3) preceded by an optional reference bar signal (C_1) or a reference 200 kHz sinewave signal (C_2).

Line 330

A 10 μs white bar (B_2), a 2 T sine-squared pulse (B_1) and a 5-riser staircase with superimposed colour sub-carrier (D_2).

Line 331

A chrominance bar signal (G_1) or a three-level chrominance signal (G_2), followed by a sub-carrier reference bar (E).

4. *525-line insertion test signal* (I.T.S.)

C.C.I.R. Recommendations 420-2 and 473 state that for 525-line television signals, lines 17 of both fields (lines 17 and 280 if numbered consecutively) are reserved for international insertion test signals.

The exact form of the test signals to be inserted in lines 17 of both fields (lines 17 and 280 if numbered consecutively) is currently under study.

5. *Measurements on insertion test signals* (I.T.S.)

In order to carry out measurements on an insertion test signal, stations and centres should also be equipped with a line selector which enables only the test signal line (or lines) to be displayed on the oscilloscope.

Measurements which can be made with the above signals are tabulated below:

5.1 *625-line monochrome only signal (1/N.67) (C.C.I.R. Recommendation 420-2)*

Characteristics measured	Waveform used	Line number
Linear distortions		
Insertion gain	B_2	17 and 330
Line-time waveform distortion	B_2	17 and 330
Short-time waveform distortion		
— step response	B_2	17 and 330
— pulse response	B_1	17 and 330
Non-linear distortions		
Line-time non-linearity	D_1	17 and 330

[1] As an interim measure some organizations may decide to omit some of the waveforms, but in this case care must be taken not to alter the mean values appreciably.

[2] A colour burst is present in the line blanking period during colour transmissions. In the case of PAL colour transmissions the chrominance sub-carrier of the insertion signals is locked at 60° from the (B-Y) axis.

5.2 625-line monochrome or colour signal (2/N.67) (C.C.I.R. Recommendation 473)

Characteristics measured	Waveform used	Line number
Linear distortions		
Insertion gain	B_2	17 and 330
Amplitude/frequency response	C_3 and C_1 or C_2	18
Line-time waveform distortion	B_2	17 and 330
Short-time waveform distortion		
— step response	B_2	17 and 330
— pulse response	B_1	17 and 330
Luminance-chrominance gain inequality	B_2 and G_1 or G_2	17 and 330, 331
	B_2 and F	17
	C_3[a] and C_1 or C_2	18
Luminance-chrominance delay inequality	F	17
Non-linear distortions		
Line-time non-linearity	D_1	17
Chrominance non-linearity	G_1, G_2 and E or F	331, 17
Luminance-chrominance intermodulation		
— differential gain	D_2	330
— differential phase	D_2 and E	330 and 331
Chrominance-luminance intermodulation	G_1, G_2 or F	331, 17

[a] Waveforms type C used only if frequency of the burst No. 4 in C_3 equals 4.43 MHz.

6. *Insertion and removal of test signals in the field blanking period*

6.1 *International signals*

The appropriate international signals [1] inserted by the originating broadcasting organization should be transmitted to the point of destination of the television connection. Exceptionally, if the connection includes a standards or colour systems convertor which does not pass signals occurring during the field blanking period, then the signals should be monitored at the upstream video point nearest to the convertor and new international signals, to the appropriate standard, should be inserted at the downstream point nearest to the convertor. The test signals should be available at any video connection point in order to facilitate assessment of performance. They may also be of use in carrying out any necessary readjustment of correctors at the final destination.

6.2 *National signals*

Any test signals inserted in lines 18 to 20 (525-line systems), or 19 to 21 (625-line systems) and the corresponding lines in the second field in either standard, should be regarded as national signals and should be removed at a suitable video point within the national frontier so that downstream countries on the circuit may use these lines for their own needs. Exceptionally, and subject to agreement between all the countries concerned, national signals may be transmitted across international frontiers.

[1] C.C.I.R. Report, 314-2 contains a proposal that lines 22 (335) on 625-line systems should be blanked by the originating broadcasting organization and be reserved for the measurement of noise on international circuits. This report also proposes that lines 16 (329) should be used for data signals.

7. *General implementation*

It is requested that Administrations of countries where national broadcasting organizations have the sole right of transmitting television signals should approach those organizations in order that the principles of this Recommendation may be applied as widely as possible.

Recommendation N.68

MONITORING FOR CHARGING PURPOSES; RELEASE OF LINE

The monitoring of an international television transmission for charging purposes is carried out at the terminal I.T.C. of the international television link.

The technical staff of the designated I.T.C. should come to an agreement among themselves so that at the end of the television transmission they have accurate knowledge of:

a) the time of handling over the television link to the broadcasting organization (beginning of chargeable duration);

b) the time at which the television link is released by the broadcasting organization (end of chargeable duration);

c) where appropriate, the times and duration of every interruption or incident which may have occured (in order that the operating services can determine whether a rebate is due and, if so, its amount).

The times of the beginning and of the end of the chargeable duration, as well as the time of occurrence and duration of any breakdowns which may occur, are entered on a daily report. This daily report is sent on the same day to the service responsible for coordinating all the details necessary for the establishment of the international accounts.

The conditions for the provision and lease of circuits for television transmissions are given in Recommendation E.330 of Volume II-A of the C.C.I.T.T. *Green Book*.

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CHAPTER 3

TRANSMISSION

Recommendation J.61 (modified at Geneva, 1964, and at Mar del Plata, 1968)

SPECIFICATIONS FOR A LONG-DISTANCE TELEVISION TRANSMISSION (System I excepted) [1]

The C.C.I.T.T.,

considering

the agreement reached by the Joint C.C.I.R./C.C.I.T.T. Committee for television transmission (C.M.T.T. on a draft Recommendation concerning television transmission over long distances, common to the C.C.I.R. and the C.C.I.T.T.),

unanimously recommends

that, taking account of the definitions in § 1, television transmissions over long distances should satisfy the requirements laid down in §§ 2 and 3 and their Annexes.

1. Definitions

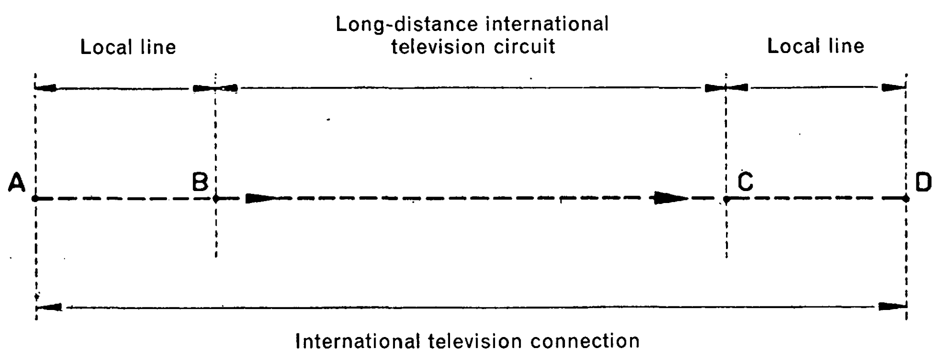

FIGURE 1/J.61

1.1 *Definition of a long-distance international television connection* (see Figure 1/J.61)

1.1.1 Point A, to be considered as the sending end of the international television connection, may be the point at which the programme originates (studio or outside location), a switching centre or the location of a standards converter.

1.1.2 Point D, to be considered as the receiving end of the international television connection, may be a programme mixing or recording centre, a broadcasting station, a switching centre or the location of a standards converter.

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[1] For System I see Recommendation J.62.

1.1.3 The local line AB connects point A to the sending terminal station, point B, of the international television circuit.

1.1.4 The long-distance international television circuit, BC, comprises a chain of national and international television links. The precise locations (e.g. within buildings), to be regarded as the points B and C, will be nominated by the authorities concerned.

1.1.5 The local line CD connects point C, the receiving terminal station of the long-distance international television circuit, to the point D.

1.1.6 The combination AD, of the long-distance international television circuit, BC, and the local lines AB and CD, constitutes the *international television connection*.

The requirements given in paragraphs 2 and 3 refer to the performance of long-distance international television circuits only; no requirements have been laid down for the local lines, AB and CD.

1.2 *Definition of the hypothetical reference circuit*

The main features of the television hypothetical reference circuit, which is an example of a long-distance international television circuit (BC in Figure 1/J.61) and which may be of either radio or coaxial-cable type, are:

— the overall length between video terminal points is 2500 km (about 1600 miles),
— two intermediate video points divide the circuit into three sections of equal length,
— the three sections are lined up individually and then interconnected without any form of overall adjustment or correction,
— the circuit does not contain a standards converter or a synchronizing-pulse regenerator.

Note 1. — The concept of the hypothetical reference circuit serves to provide a basis for the planning and design of transmission systems. Such a circuit has a length which is reasonably but not excessively long and, for a television circuit, a defined number of video-to-video sections. It is appreciated that, at the present time, international television circuits usually contain more than three video-to-video links in a length of 2500 km, but it is expected that the number will be reduced in the course of time. Annex IV gives a provisional indication of the characteristics of circuits with more or fewer video sections than the hypothetical reference circuit.

Note 2. — In Canada and the United States of America, objectives are normally specified for circuits 6400 km long. The limits given in this Recommendation for 2500-km circuits for the 525-line system in Canada and the United States of America are therefore chosen to give an adequate performance in a 2500-km portion of a 6400-km circuit.

2. Requirements at video interconnection points

In this section the requirements apply at the video terminals of any long-distance television circuit, whatever its length.

2.1 *Impedance*

At video interconnection points, the input and output impedance of each circuit should be unbalanced to earth, with a nominal value of 75 Ω resistive and a return loss of at least 24 dB relative to 75 Ω. The return loss, relative to 75 Ω, of an impedance Z is

$$20 \log_{10} \left| \frac{75 + Z}{75 - Z} \right| \text{ (dB).}$$

Note 1. — In Canada and the United States of America, the impedance at video interconnection points should be either 124 Ω balanced to earth or 75 Ω unbalanced to earth, with a return loss of at least 30 dB.

Note 2. — In some countries, impedance is specified in terms of "waveform return loss" [see Doc. CMTT/9 (O.I.R.T.), 1963-1966 and Recommendation 451-1].

2.2 *Polarity and d.c. component*

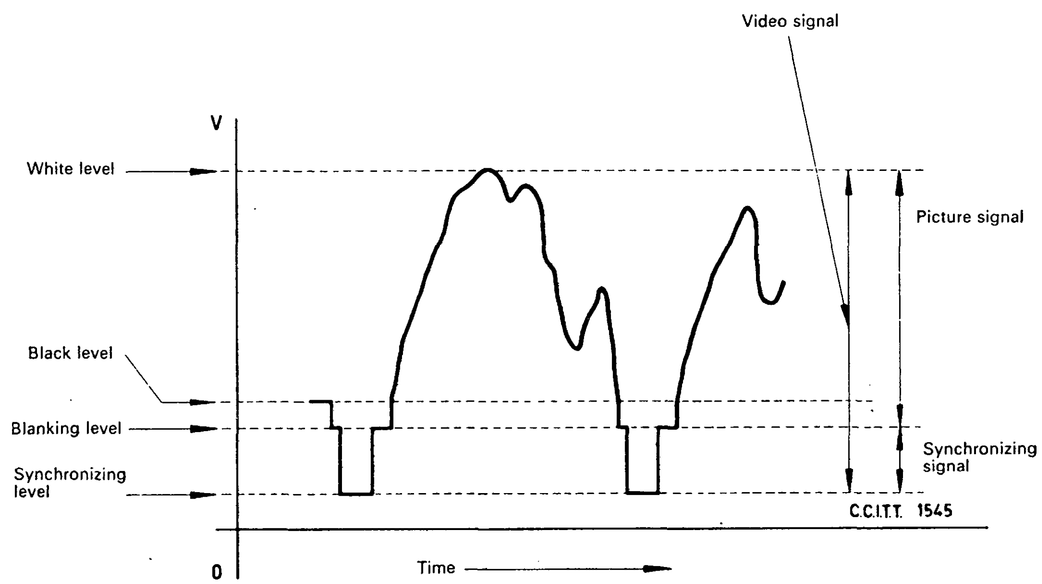
At video interconnection points, the polarity of the signal should be *positive*, i.e. such that black-to-white transitions are positive-going.

The useful d.c. component, which is related to the average luminance of the picture, may or may not be contained in the video signal and need not be transmitted, or delivered at the output.

Any non-useful d.c. component unrelated to the video signal (e.g. the component due to d.c. valve supplies) should not cause more than 0.5 W to be dissipated in the 75 Ω load impedance. If the load impedance is disconnected, the voltage of this component should not exceed 60 V.

2.3 *Signal amplitude*

At video interconnection points, the blanking level taken as the reference level, the nominal amplitude of the picture signal, measured from the blanking level to the white level should be 0.7 V (0.714 V in Canada and the United States of America), while the nominal amplitude of the synchronizing signal, measured from the blanking level to the tips of the synchronizing pulses should be 0.3 V (0.286 V in Canada and the United States of America). so that the nominal peak-to-peak amplitude of the video signal should be 1.0 V (see Figure 2/J.61).



V = Difference in potential between the terminal (not at earth potential) of the input (or output) impedance and earth (difference of potential positive in an upward direction)

FIGURE 2/J.61

Theoretically, the amplitude should be measured with the useful d.c. component of the video signal restored, but in practice this is not necessary.

Note 1. — In the design of equipment, account should be taken of the losses in interconnecting cables when the video interconnection points are at some distance from the terminals of the modulating and demodulating equipment.

Note 2. — For colour in system M (Japan), the above specification applies to the luminance and synchronizing signals. For the chrominance signal, further study is required.

3. Transmission performance of the hypothetical reference circuit

In this section, the performance requirements are to be taken as design objectives applying to the hypothetical reference circuit as defined in paragraph 1.2.

It should be emphasized that the material of this section constitutes only a first step towards the solution of the general problem of determining methods of measuring and specifying the performance of television circuits of any length or degree of complexity.

3.1 *Insertion gain*

A long-distance international circuit, having the form of the hypothetical reference circuit should, at the time of setting up, have an insertion gain of 0 dB ± 1 dB (± 0.5 dB in Canada and the United States of America).

The insertion gain should be measured, using Test Signal No. 2 (described in Annex I) and is defined as the ratio, in dB, of the amplitude of the bar (from black level to white level) at the output to the nominal amplitude of the bar at the input.

The measurement should be made under the following conditions:

a generator producing Test Signal No. 2, with an internal impedance of 75 Ω (resistive), is adjusted so that, if connected directly to a 75 Ω resistance, it would produce a line-synchronizing signal of 0.3 V combined with a picture signal of 0.7 V which may include 0.05 V of pedestal. At the receiving end, the voltage between the black level and the white level (bar amplitude) is measured, using an oscilloscope connected across a resistance of 75 Ω. The ratio of this voltage to 0.65 V if pedestal is used, or 0.7 V if it is not (in dB), is the insertion gain of the television circuit.

Note. — In Canada and the United States of America somewhat different methods are used, but similar results are obtained.

3.2 *Variations of insertion gain*

The variations of insertion gain with time in the hypothetical reference circuit should not exceed the following limits:

— short-period (e.g. 1 s) variations: ± 0.3 dB (± 0.2 dB in Canada and the United States of America),

— medium-period (e.g. 1 hour) variations: ± 1.0 dB.

3.3 *Noise*

3.3.1 *Continuous random noise*

The signal-to-weighted noise ratio for continuous random noise is defined as the ratio, in decibels, of the peak-to-peak amplitude of the picture signal (see Figure 2/J.61) to the r.m.s.[1] amplitude of the noise, within the range between 10 kHz and the nominal upper limit of the video frequency band of the system, f_c. The purpose of the lower frequency limit is to enable power supply hum and microphonic noise to be excluded from practical measurements.

For the hypothetical reference circuit, the signal-to-noise ratio should not be less than the values X given in Table 1 when measured with the appropriate low-pass filter, described in Annex II, the appropriate weighting network described in Annex III, and an instrument having an "effective time constant" or "integrating time" in terms of power of 1 s (0.4 s in Canada and the United States of America).

[1] Administrations measuring the quasi-peak-to-peak amplitude of the noise are asked to establish the crest factor appropriate to their method of measurement and to express the results in terms of r.m.s. amplitude.

TABLE 1

System (see Report 308-2)	M (Canada and U.S.A.)	M (Japan) monochrome and colour	B, C, G, H	D, K, L	F	E
Number of lines	525	525	625	625	819	819
Nominal upper limit of video-frequency band f_c (MHz)	4	4	5	6	5	10
Signal-to-weighted noise ratio X (dB)	56	52	52	57	52	50

Note 1. — To obtain satisfactory transmission performance, television specialists believe that the signal-to-weighted noise ratio should fall neither below X (dB) for more than 1% of any month, nor below $X - 8$ dB for more than 0.1% of any month.

Note 2. — For the routine measurement of signal-to-noise ratio on real circuits, the noise can be measured with sufficient accuracy in the absence of the video signal. The error introduced by this method will not, in general, exceed 2 dB. More accurate devices and methods for measuring signal-to-weighted noise ratio when transmitting test signals, are described in Docs. XI/25, Moscow, 1958, C.M.T.T./23, Monte Carlo, 1958, and C.M.T.T./3, Paris, 1962, presented by the U.S.S.R.

TABLE 2

System	M (Canada and U.S.A.)	M (Japan)	B, C, G, H	D, K, L	F	E
Number of lines	525	525	625	625	819	819
Nominal upper limit of video frequency band f_c (MHz)	4	4	5	6	5	10
Signal-to-noise ratio (dB) for power-supply hum (including the fundamental frequency and lower-order harmonics) [a]	35	30	30	30	30	30
Signal-to-noise ratio (dB) for single-frequency noise between 1 kHz and 1 MHz	59 [b]	50	50	50	50	50 [c]
Value (dB) to which the signal-to-noise ratio for single-frequency noise may decrease linearly between 1 MHz and f_c	43 [d]	30 [f]	30	30	30	30 [e]

[a] These figures apply only to hum added to the signal and not to hum which in transmission has modulated the amplitude of the signal and cannot be removed by clamping. The measurement should be made without clamping.

[b] This limit applies between 1 kHz and 2 MHz.

[c] For system E for frequencies below 1 kHz excluding power-supply hum (including both the fundamental frequency and lower-order harmonics), the signal-to-noise ratio may decrease linearly between the values 50 dB at 1 kHz and 45 dB at 100 Hz and between the value 45 dB at 100 Hz and 30 dB at 50 Hz.

[d] Value to which the signal-to-noise ratio may decrease, according to a linear function on a chart having a linear scale and a logarithmic frequency scale, for frequencies between 2 MHz and f_c (4 MHz).

[e] For system E this figure is reached at a frequency of 7 MHz and remains constant between 7 MHz and f_c (10 MHz).

[f] For colour system M (Japan) the signal-to-noise ratio should not be less than 50 dB at 3.6 MHz.

3.3.2 *Periodic noise*

The signal-to-noise ratio for periodic noise is defined as the ratio, in dB, of the peak-to-peak amplitude of the picture signal (see Figure 2/J.61) to the peak-to-peak amplitude of the noise.

Note. — This definition has so far been used in specification clauses dealing with single-frequency noises and with power-supply hum (including the fundamental frequency and lower-order harmonics), but it may also prove to be useful for any case in which two or more sinusoidal components are in harmonic relationship.

The signal-to-noise ratio in the hypothetical reference circuit should not be less than the value given in Table 2.

3.3.3 *Impulsive noise*

The signal-to-noise ratio for impulsive noise is defined as the ratio, in dB, of the peak-to-peak amplitude of the picture signal (see Figure 2/J.61) to the peak-to-peak amplitude of the noise.

Provisionally, for the hypothetical reference circuit, a minimum signal-to-noise ratio of 25 dB for impulsive noise of a sporadic or infrequently occurring nature has been proposed for all systems, except system M (Canada and the United States of America), for which the requirement is 11 dB.

3.3.4 *Crosstalk*

This matter is still under study.

3.4 *Non-linear distortion*

Non-linear distortion affects both the picture and the synchronizing signals.

Non-linear distortions of the picture signal may be classified under three headings [1], namely:

— field-time non-linear distortion,
— line-time non-linear distortion,
— short-time non-linear distortion.

3.4.1 *Field-time non-linear distortion of the picture signal*

This matter is still under study.

3.4.2 *Line-time non-linear distortion of the picture signal*

Non-linear distortion of the picture signal is measured with Test Signal No. 3 (described in Annex I), using a superimposed sine-wave at a frequency 0.2 f_c.

The magnitude of the distortion is indicated by the ratio of the minimum peak-to-peak amplitude of the sine-wave to the maximum amplitude along the saw-tooth.

The sine-wave may be displayed on an oscilloscope with the time base running at line frequency by using a band-pass filter to separate the sine-wave from the rest of the signal. The display then has the form indicated in Figure 3/J.61 and the line-time non-linear distortion is indicated by changes in amplitude across the display.

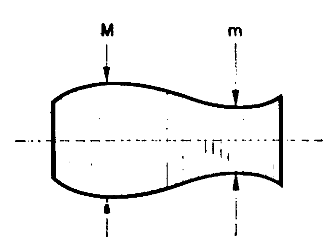


FIGURE 3/J.61

[1] The corresponding terms in French are respectively: *distorsion de non-linéarité aux fréquences très basses, aux fréquences moyennes, aux fréquences élevées.*

The non-linear distortion should be expressed as a percentage, in the form $100\,(1-m/M)$ and should not be more than 20% for the hypothetical reference circuit. Alternatively, the result may, if desired, be expressed in dB in the form $(20 \log_{10} M/m)$ and for the hypothetical reference circuits should not exceed 2 dB.

For system M (Canada and the United States of America), the non-linear distortion is measured with a superimposed sine-wave of 0.143 V peak-to-peak at 3.6 MHz and the results are expressed either as a percentage or in dB and should not be more than 13% or 1.2 dB respectively.

For colour system M (Japan), using the same test signal, the differential gain should not exceed 10%, and the differential phase should not exceed 5°.

3.4.3 *Short-time non-linear distortion of the picture signal*

This matter is still under study [1].

In Canada and the United States of America, the short-time non-linear distortion requirement is covered by the non-linearity distortion requirement given in paragraph 3.4.2.

3.4.4 *Non-linear distortion of the synchronizing signal*

For the hypothetical reference circuit, when the gain of the circuit is 0 dB, the amplitude, S, of the line-synchronizing signal, measured with Test Signal No. 3, should lie between the limits of 0.21 V and 0.33 V (0.26 V and 0.31 V for Canada and the United States of America), irrespective of whether the intermediate lines are at black level, S_a, or at white level, S_b.

3.5 *Linear waveform distortion*

3.5.1 *Field-time waveform distortion*

3.5.1.1 Systems B, C, D, E, F, G, H, K, L

For the hypothetical reference circuit, using Test Signal No. 1 (described in Annex I) the received waveform displayed on an oscilloscope should lie within the limits of the mask shown in Figure 4/J.61, provided that the oscilloscope is adjusted so that the half-amplitude points of the bar transitions coincide with M_1 and M_2, and the mid-points of the "black" and "white" portions coincide with A and B respectively.

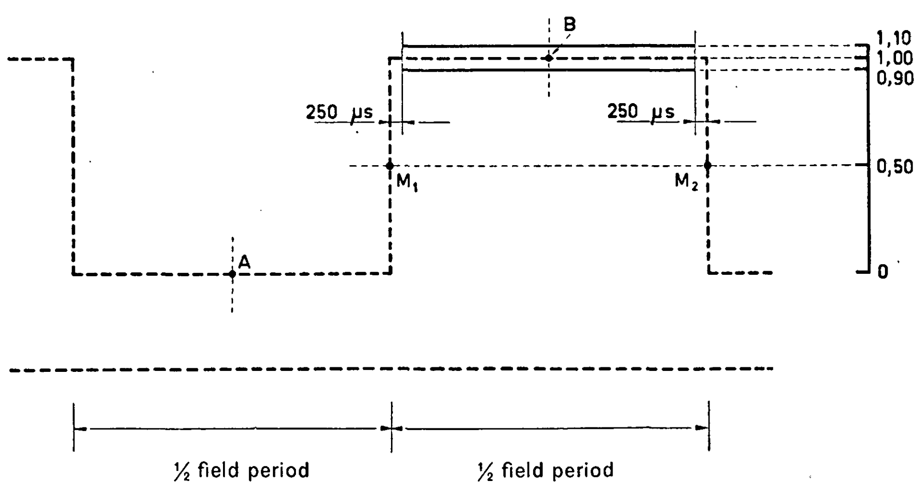


FIGURE 4/J.61. — **Waveform response to Test Signal No. 1**

[1] In several countries, such measurements are at present being made using Test Signal No. 3 with a higher value than $0.2\,f_c$ for the frequency of the superimposed sine-wave (see Doc. C.M.T.T./41, Monte Carlo, 1958 — Chairman's Report).

3.5.1.2 System M

In Canada and the United States of America, with Test Signal No. 1, the variations about the level B should not exceed $\pm 5\%$ when the signal is unclamped or $\pm 1\%$ when the signal is clamped.

In Japan, with Test Signal No. 1, the tolerances are the same as for the 625- and 819-line systems.

3.5.2 *Line-time waveform distortion*

3.5.2.1 System M

In Canada and the United States of America, for the hypothetical reference circuit, using Test Signal No. 2 (described in Annex I) with a rise-time of $2T$ (0.25 µs), the received waveforms displayed on an oscilloscope should lie within the limits of the corresponding mask, similar to that shown in Figure 5/J.61, but with a permitted variation about the level B of $\pm 1\%$ provided that the oscilloscope is adjusted so that the half-amplitude points of the bar transitions coincide with M_1 and M_2, and the mid-points of the "black" and "white" portions coincide with A and B respectively.

In Japan, the conditions described below for the 625- and 819-line systems apply.

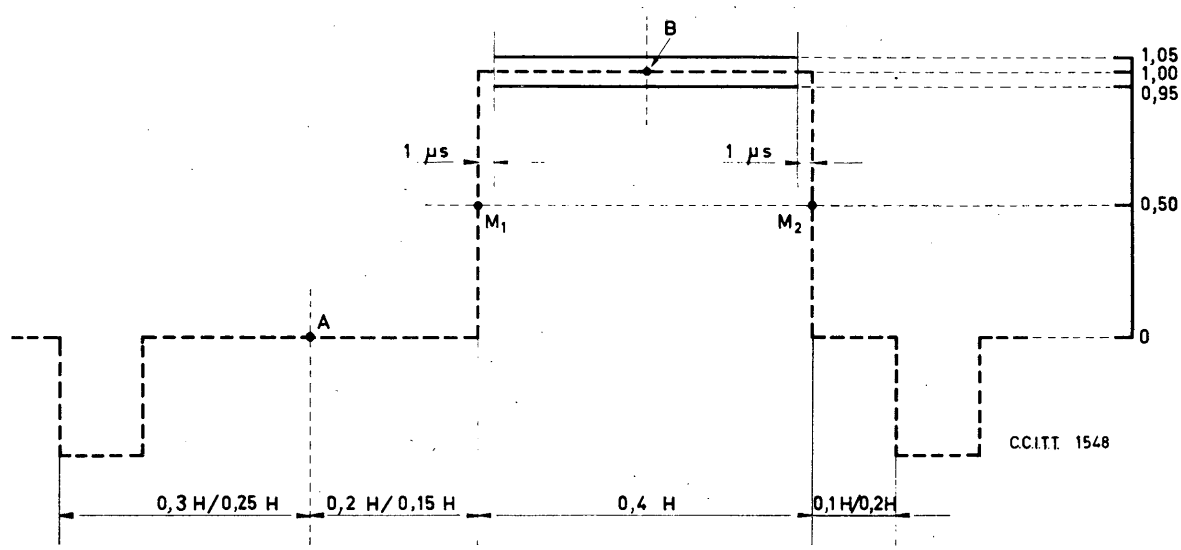


FIGURE 5/J.61. — **Waveform response to Test Signal No. 2**

3.5.2.2 Systems B, C, D, E, F, G, H, K, L

For the hypothetical reference circuit, using Test Signal No. 2 (described in Annex I), with a rise-time of T (it may be necessary to use a rise-time of $2T$ for circuits which cut off sharply close to the nominal upper video-frequency limit), the received waveform displayed on an oscilloscope should lie within the limits of the mask shown in Figure 5/J.61, provided that the oscilloscope is adjusted so that the half-amplitude points of the bar transitions coincide with M_1 and M_2, and the mid-points of the "black" and "white" portions coincide with A and B respectively.

3.5.3 *Short-time waveform distortion*

3.5.3.1 System M

In Canada and the United States of America, where a test signal comprising a sine-squared pulse of half-amplitude duration $1/(2f_c)$ s is used, the output signal should have a first-overshoot amplitude (negative), leading or trailing, not greater than 13% of the peak amplitude of the pulse.

In Japan, the test procedure is the same as that described for systems B, C, D, E, F, G, H, K, L, the response being observed by means of the mask shown in Figure 6/J.61. For the chrominance channel, further study is required.

µs	Upper limit	Lower limit
0.12	120	90
0.35	109	91
≧ 1	105	95

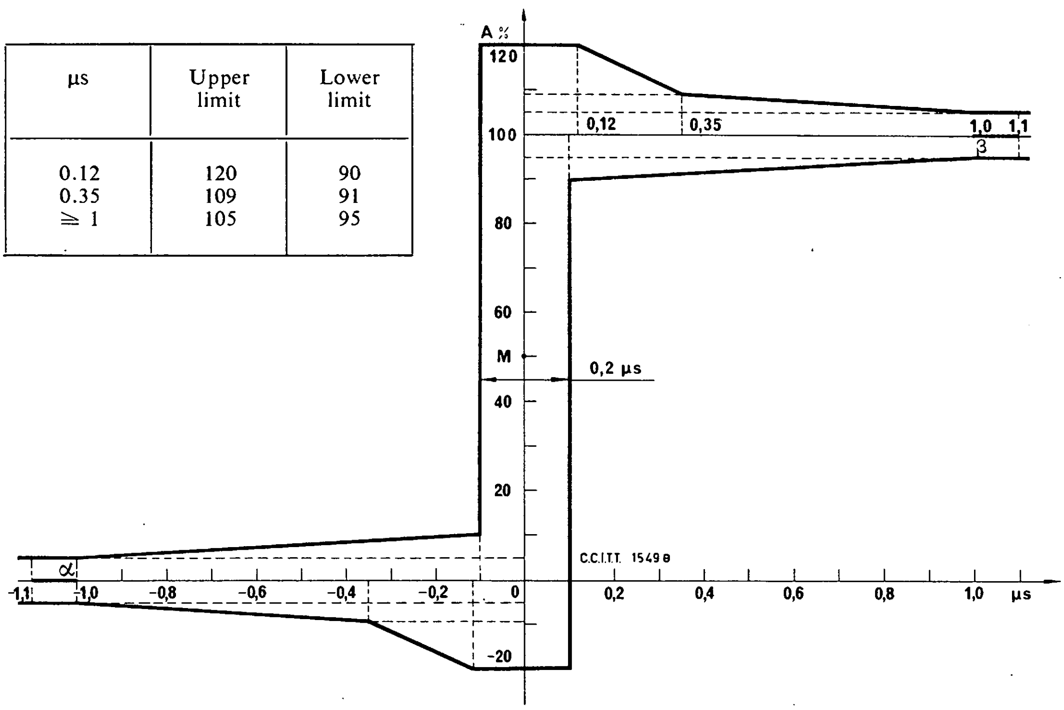


FIGURE 6/J.61. — **Mask for waveform response to Test Signal No. 2 for system M (Japan)**

3.5.3.2 Systems B, C, D, E, F, G, H, K, L

Test Signal No. 2 is used, with a rise-time of $T = 1/(2f_c)$.

The response is observed by means of one of the masks shown in Figures 7/J.61 and 8/J.61, the oscilloscope being adjusted so that M coincides with the middle of the rise, and the black and white levels coincide with the segments α and β.

If ringing is present in the regions α and β, the peaks of the oscillations should be set symmetrically with respect to α and β.

For the hypothetical reference circuit, the response should be within the limits of the appropriate mask as follows:

— Figure 7/J.61 for systems D, K.

— Figure 8/J.61 for systems B, C, E, F, G, H (see Note).

Note. — For 625-line L-system, the mask for the waveform response to Test Signal No. 2 is provisionally the mask of Figure 8/J.61 corresponding to the 819-line system E (f_c = 10 MHz).

3.6 *Steady-state characteristics*

3.6.1 *System M*

In Canada and the United States of America, the design-objective limits are shown by the lines B in Figures 10/J.61 and 11/J.61, the lowest frequency to which these limits apply being 0.0025 f_c.

μs	Upper limit	Lower limit
0.08	120	90
0.28	109	91
≥ 1	105	95

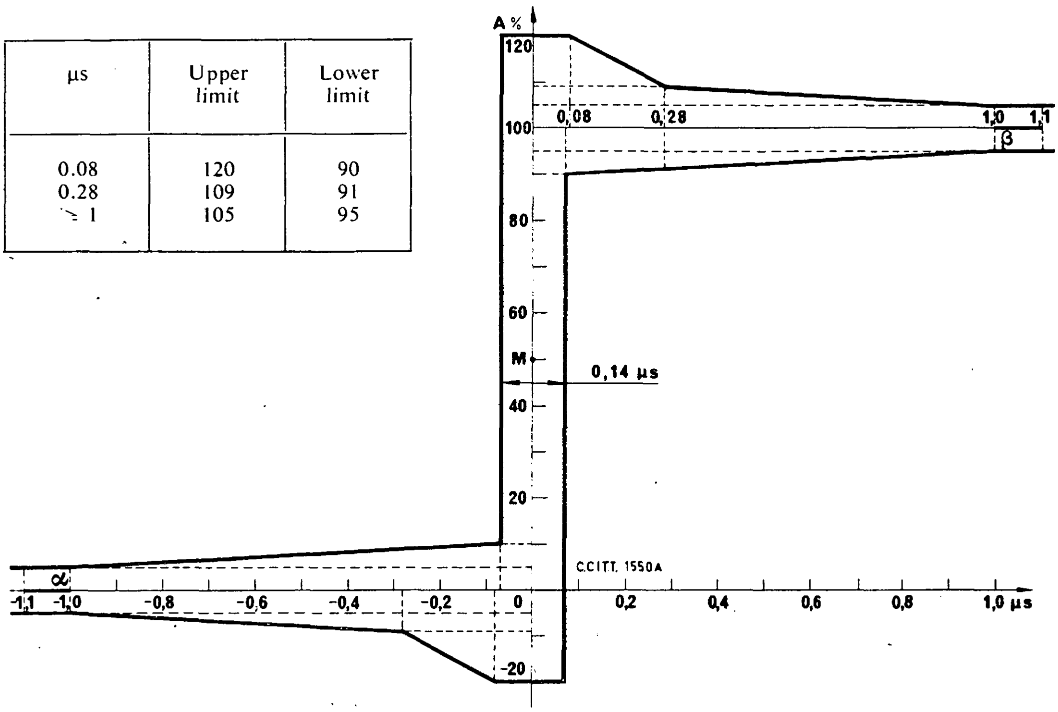
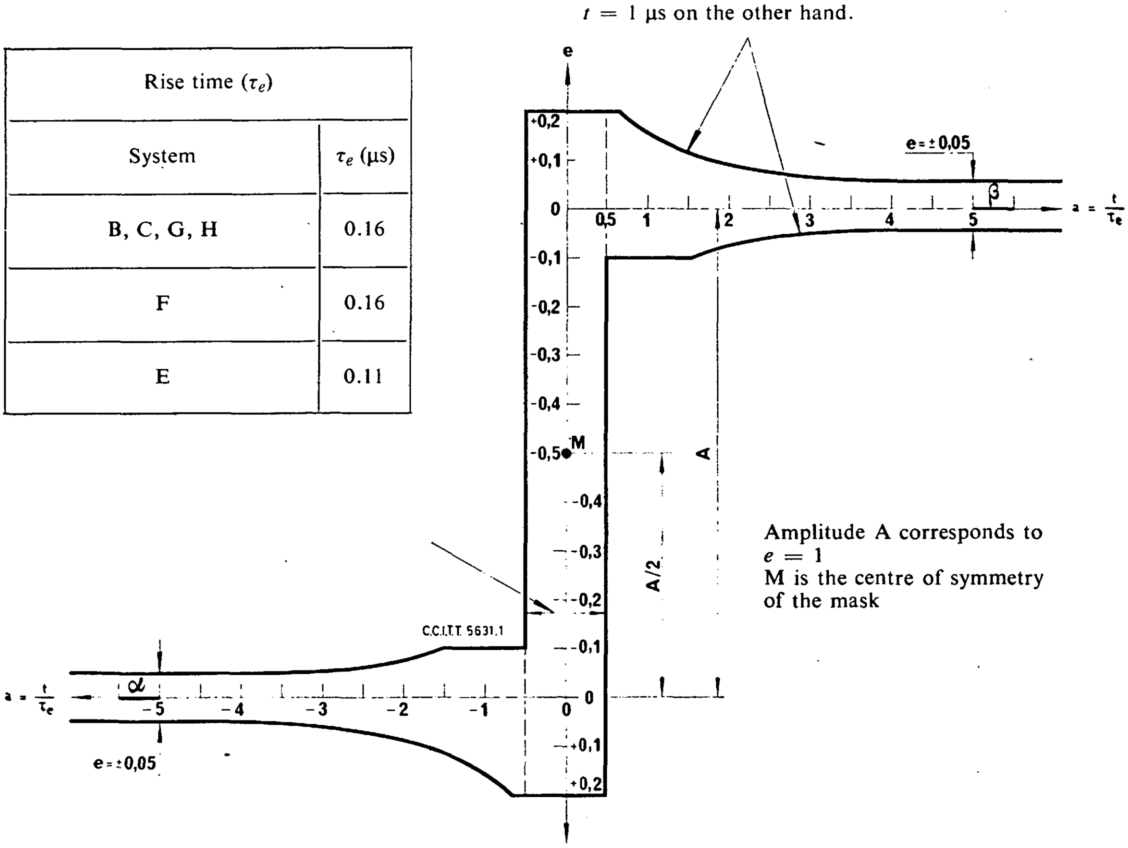


FIGURE 7/J.61. — **Provisional mask for waveform response to Test Signal No. 2 for systems D, K**

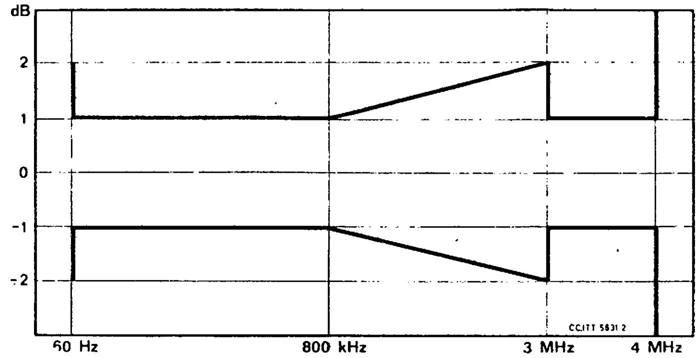
Mask formed by a part of the curve defined by: $\pm e = \frac{1}{8a} + 0.025$ within the limits: $e = +0.2$ and $e = -0.1$ on the one hand, and $e = \pm 0.05$ up to $t = 1$ μs on the other hand.

Rise time (τ_e)	
System	τ_e (μs)
B, C, G, H	0.16
F	0.16
E	0.11



Amplitude A corresponds to $e = 1$
M is the centre of symmetry of the mask

FIGURE 8/J.61. — **Mask for waveform response to Test Signal No. 2 of systems B, C, E, F, G, H**



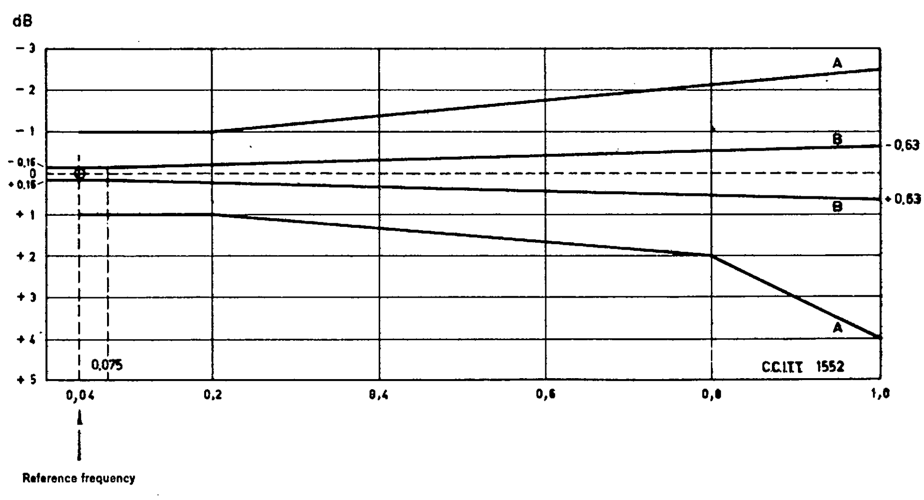
f_c: nominal upper limit of video-frequency band

FIGURE 9/J.61. — **Limits for the attenuation/frequency characteristic of System M for colour television (Japan)**

In Japan the limits are as indicated below for the 625-line and 819-line systems, the appropriate value of f_c being 4 MHz. For colour, the attenuation/frequency limits are indicated in Figure 9/J.61; the envelope-delay/frequency limits require further study.

3.6.2 Systems B, C, D, E, F, G, H, K, L

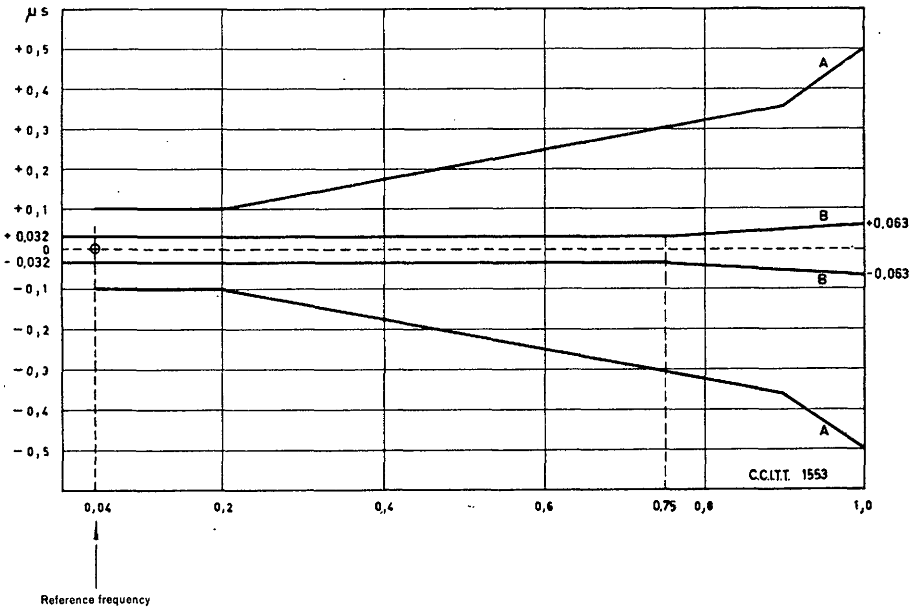
For the hypothetical reference circuit, the limits of the attenuation/frequency and envelope-delay/frequency characteristics given in Figures 10/J.61 and 11/J.61 may be found useful by designers. In these figures, the abscissae show a single parameter which is the ratio between the frequency and the nominal upper video frequency, f_c, of the system considered (normalized frequency).



Curves A: With nominal upper limits of the video-frequency band f_c = 4 MHz, system M (Japan), 5 MHz, systems B, C, F, G, H; 6 MHz, systems D, K, L; 10 MHz, system E.

Curves B: For system M (Canada and the United States of America), f_c = 4 MHz.

FIGURE 10/J.61. — **Limits for the attenuation/normalized-frequency characteristic for television systems**



Curves A: With nominal upper limits of the video-frequency band f_c = 4 MHz, system M (Japan); 5 MHz, systems B C, F, G, H; 6 MHz, systems D, K, L; 10 MHz, system E.

Curves B: For system M (Canada and the United State of America), f_c = 4 MHz.

FIGURE 11/J.61. — **Limits for the envelope-delay/normalized-frequency characteristic for television systems**

ANNEX I

(to Recommendation J.61)

Test signals

1. Test Signal No. 1

Test Signal No. 1 is used in the measurement of field-time waveform distortion. As shown in Figure 12/J.61 below, it comprises a square wave of field frequency superimposed upon line-synchronizing and blanking pulses. If desired, a field-synchronizing signal may be included and the pedestal may be omitted.

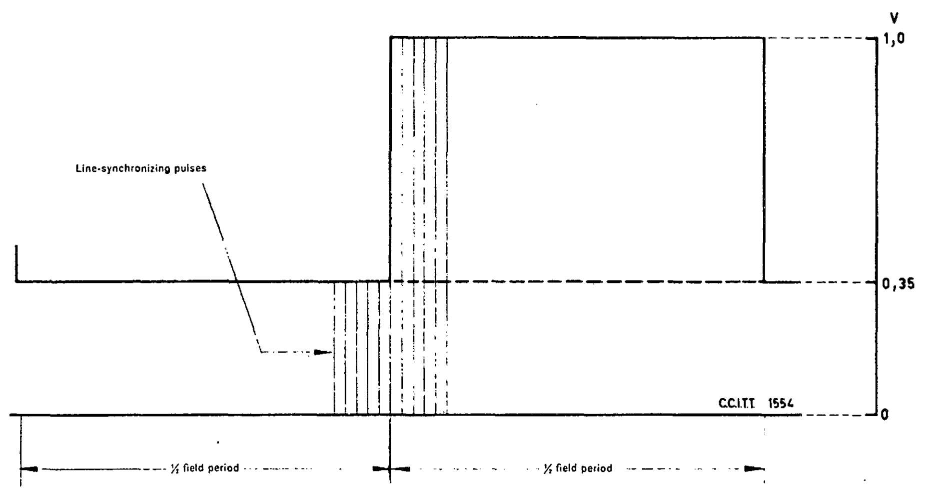


FIGURE 12/J.61. — **Test Signal No. 1**

2. Test Signal No. 2 [1]

Test Signal No. 2 is used in the measurement of insertion gain, line-time waveform distortion and short-time waveform distortion. As shown in Figure 13/J.61, it comprises a half-line bar associated with line-synchronizing pulses. If desired, a field-synchronizing signal may be included. The interval between the half-line bar and the succeeding synchronizing pulse may be either 0.1 H or 0.2 H, where H is the line period. The pedestal may be omitted if desired.

The precise shape and rise-time of each transition of the half-line bar may be determined by means of a shaping network, the design of which is based on "Solution 3" in a paper by W. E. Thomson [*Proc. I.E.E.*, Part III, **99**, 373 (1952)]. Two alternative networks may be used giving rise-times of T and $2T$, where $T = 1/(2f_c)$, and f_c is the nominal upper video-frequency limit of the system. (Annex IV of the paper by Thomson contains a description of the appropriate network.)

If desired, an additional feature such as a sine-squared pulse, of shape and half-amplitude duration determined by the above-mentioned shaping networks, or a high-frequency burst, can be added in the space marked A. For systems D and K, a sine-squared pulse of half-amplitude duration T or $2T$ is used.

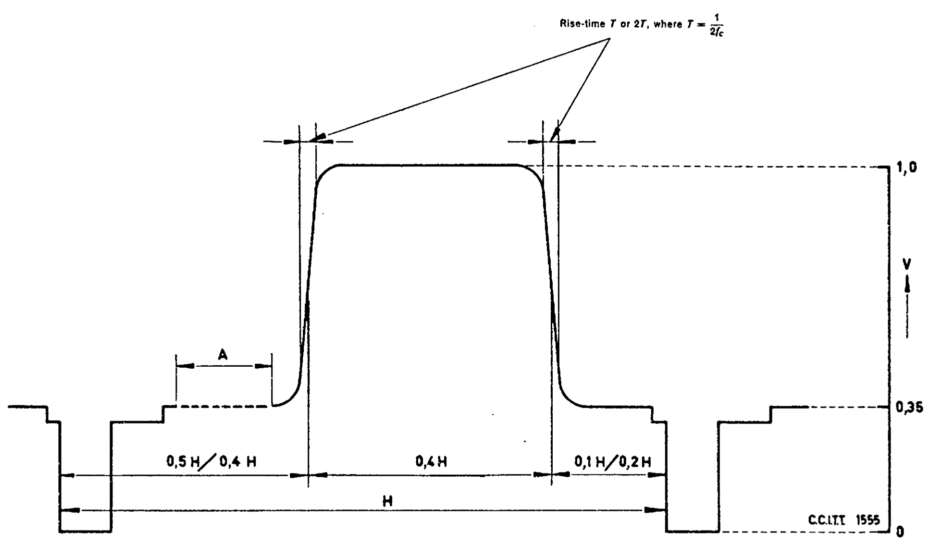


FIGURE 13/J.61. — **Test Signal No. 2**

3. Test Signal No. 3 [1]

Test Signal No. 3 is used in the measurement of non-linear distortion. As shown in Figure 14/J.61, it is a signal in which the "picture" portion of every fourth line consists of a sine-wave of 0.1 V peak-to-peak amplitude superimposed on a saw-tooth, the three intermediate lines being set either to black level or to white level by means of a switch at the sending end. If desired, a field-synchronizing signal may be included and the pedestal may be omitted.

For measuring line-time non-linearity distortion, the frequency of the superimposed sine-wave is $0.2\ f_c$.

At the receiving end of a circuit, any variation of the sine-wave amplitude over the duration of the saw-tooth is taken as indicative of non-linearity distortion.

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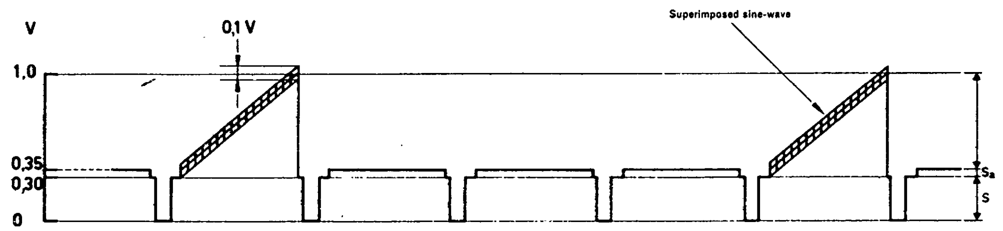
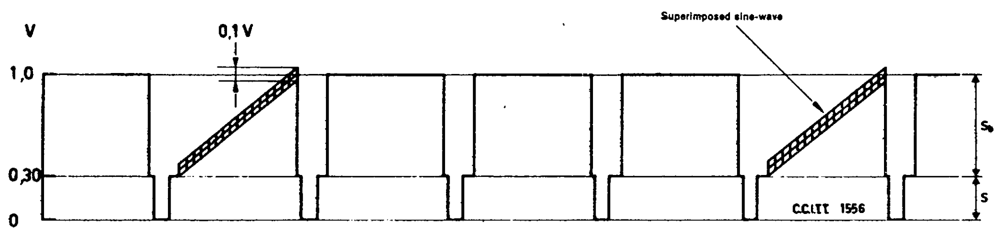
[1] Considerable errors in measurement occur when using Test Signals Nos. 2 and 3, if the signal-to-noise ratio is less than 30 dB (see Doc. C.M.T.T./2, Paris, 1962).



(*a*) Intermediate lines at black level



(*b*) Intermediate lines at white level

FIGURE 14/J.61. — **Test Signal No. 3**

ANNEX II

(to Recommendation J.61)

Low-pass filter for use in measurements of continuous random noise

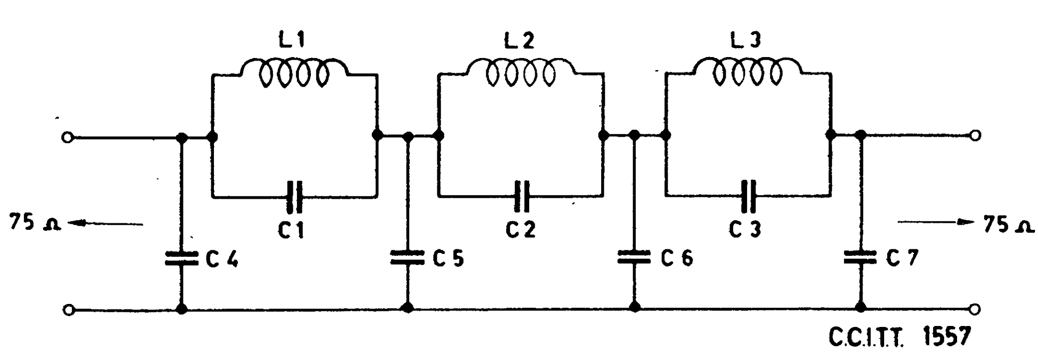
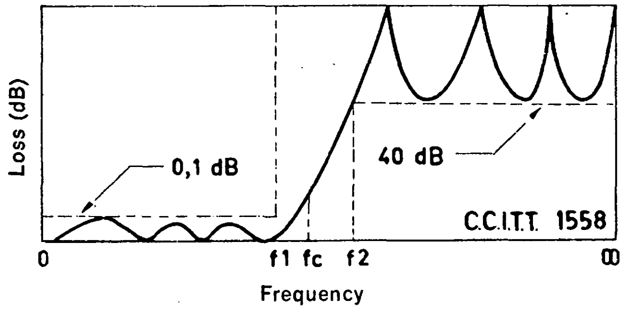


FIGURE 15/J.61

	Nominal upper video-frequency limit: f_c (MHz) [a]		
	L (μH)	C (pF)	f (MHz)
1	$14.38/f_c$	$497.6/f_c$	$1.8816\,f_c$
2	$7.673/f_c$	$2723/f_c$	$1.1011\,f_c$
3	$8.600/f_c$	$1950/f_c$	$1.2290\,f_c$
4		$2139/f_c$	
5		$2815/f_c$	
6		$2315/f_c$	
7		$1297/f_c$	

[a] For system M (Canada and the United States of America), a value of $f_c = 4.2$ MHz is adopted for the design of the low-pass filter used for noise measurement.

f/f_c	dB	f/f_c	dB
0.98	0.1	1.04	14.8
0.99	0.5	1.05	18.8
1.00	1.8	1.06	23.0
1.01	4.2	1.07	27.7
1.02	7.3	1.08	33.3
1.03	10.9	1.09	41.0



Theoretical insertion loss
$f_1 = 0.9\,f_c$ by design.

Ringing frequency $= f_c$ by design.
$f_1 = 0.9807\,f_c$
$f_2 = 1.0897\,f_c$

FIGURE 16/J.61

Note 1. — Each capacitance quoted is the total value, including all relevant stray capacitances, and should be correct to $\pm 2\%$.

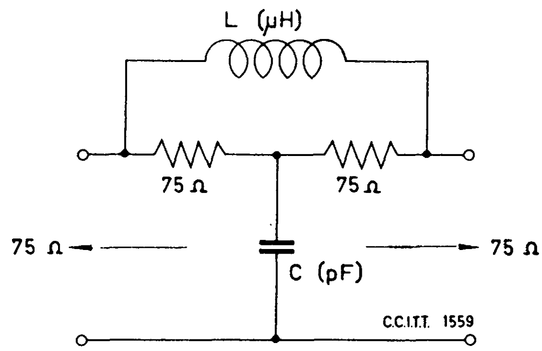
Note 2. — Each inductor should be adjusted to make the insertion loss a maximum at the appropriate indicated frequency, f (MHz).

Note 3. — The theoretical insertion loss curve above corresponds to an infinite Q-factor. In practice, Q should be at least of the order of 100 at frequency f_c.

Note 4. — Limits for the insertion-loss/frequency characteristics are specified indirectly by the indicated tolerances on the component values.

ANNEX III
(to Recommendation J.61)

Continuous random-noise weighting networks



$$L\,(\mu H) = 75\,\tau\,(\mu s);\; C\,(pF) = \frac{\tau\,(\mu s)}{75} \cdot 10^6$$

$$\text{Insertion loss (dB)} = 10 \log_{10} [1 + (2\pi\,\tau f)^2]$$

FIGURE 17/J.61

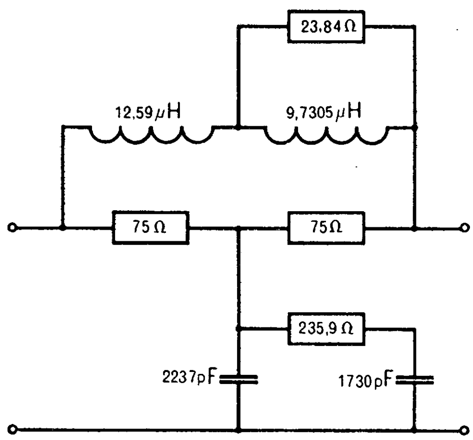
System	f_c (MHz) [a]	τ (μs)	τf_c	Theoretical weighting (dB), for:	
				"White" noise	"Triangular" noise
M (Canada and U.S.A.)	see Note 1			6.1	10.2
M (Japan)	4	0.415	1.66	8.5	16.3
B, C, G, H	5	0.33	1.66	8.5	16.3
D, K, L	6	0.33	2.0	9.3	17.8
F	5	0.33	1.66	8.5	16.3
E	10	0.166	1.66	8.5	16.3

[a] f_c is the nominal upper video-frequency limit of the system (MHz).

Note 1. — For system M (Canada and the United States of America), the following weighting characteristic is used:

Frequency (MHz)	0.01	0.05	0.10	0.50	1.00	2.00	3.00	4.00
Weighting (insertion loss) (dB)	0	0	0.3	2.8	4.7	8.1	10.8	13.0

A weighting network, such as that shown below, may be used:



$$\text{Insertion loss (dB)} = 10 \log_{10} \frac{[1 + (f/f_1)^2]\ [1 + (f/f_2)^2]}{[1 + (f/f_3)^2]}$$

where: $f_1 = 0.270$ MHz, $f_2 = 1.37$ MHz and $f_3 = 0.390$ MHz

FIGURE 18/J.61

Note 2. — For colour system M (Japan), the weighting curve of Figure 19/J.61 is used for colour [see WATANABE, K. Effects of continuous random noise on colour television pictures. *Electrical Telecomm. Laboratory.* Report No. 1528, N.T.T., Japan (1964)].

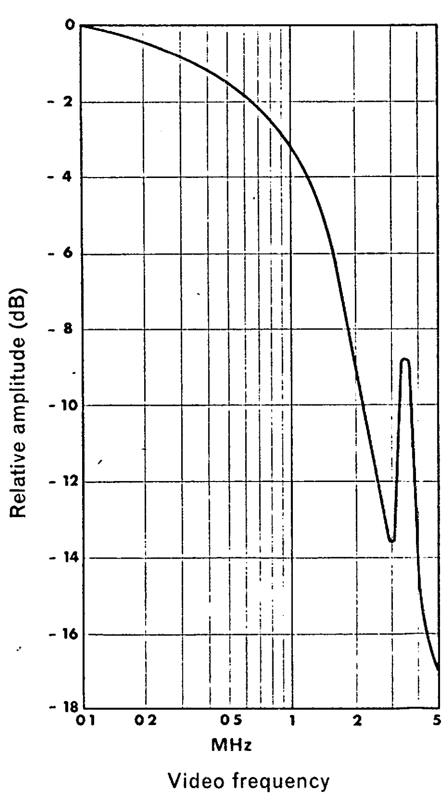


FIGURE 19/J.61. — **Weighting curve for continuous random noise of a 525-line television system**

ANNEX IV

(to Recommendation J.61)

Circuits having more or fewer video sections than the hypothetical reference circuit

1. Introduction

The purpose of this Annex is to give some indication of the design objectives of hypothetical circuits that have more or fewer video-to-video sections than the three sections of the hypothetical reference circuit defined in paragraph 1.2 of this Recommendation. The values calculable from Tables 1 and 2 provide only indications of the probable design objectives, which should be used with caution when considering specifications of actual circuits, because the law of addition is not precisely known for every type of impairment.

2. Laws of addition

If D_3: design objective as expressed in this Recommendation, or the parameter derived therefrom and indicated in Table 2, permitted in the hypothetical reference circuit,

and D_n: design objective, or the parameter mentioned above, permitted in n sections,

then
$$D_n = D_3 \left(\frac{n}{3}\right)^{1/h},$$

where h has the value 1, 3/2 or 2 in accordance with Table 2; $h = 1$ gives linear or arithmetic law of addition, $h = 3/2$ gives the "three-halves power" law of addition, and $h = 2$ gives r.s.s. or quadratic addition.

Calculated values of $\left(\frac{n}{3}\right)^{1/h}$, are given in Table 1.

TABLE 1

n	$\left(\frac{n}{3}\right)^{1/h}$		
	$h = 1$	$h = 3/2$	$h = 2$
1	0.33	0.48	0.58
2	0.67	0.76	0.82
3	1.00	1.00	1.00
4	1.33	1.21	1.15
5	1.67	1.41	1.29
6	2.00	1.59	1.41
7	2.33	1.76	1.53
8	2.67	1.92	1.63
9	3.00	2.08	1.73
10	3.33	2.23	1.83
11	3.67	2.38	1·91
12	4.00	2.52	2.00
13	4.33	2.66	2.08
14	4.67	2.79	2.16
15	5.00	2.92	2.24

TABLE 2

Relevant paragraph of this Recommendation	Characteristic	D_3 expressed in	h	Notes
3.1	*Insertion gain* (tolerance)	dB	2	
3.2	*Insertion gain variation* short period medium period	 dB dB	 2 2	
3.3.1	*Continuous random noise*			1
3.3.2	*Periodic noise* Power-supply hum 1 kHz to 1 MHz 1 MHz to f_c	 amplitude of noise	 2 2 2	 2; 7 3 3
3.3.3	*Impulsive noise*	amplitude of noise		4
3.4 3.4.2 3.4.4	*Non-linear distortion* Picture signal Synchronizing signal	$\left(1-\frac{m}{M}\right) \times 100\%$ %	3/2 3/2	7
3.5 3.5.1 3.5.2 3.5.3	*Linear waveform distortion* Field-time Line-time Short-time overshoot and ringing Rise-time	 % % mask µs	 1 2 2 no law	 7 6; 7 6; 7 7
3.6	*Steady-state characteristics* Attenuation/frequency Envelope-delay/frequency	 dB µs	 3/2 3/2	 5 5

Note 1. — For circuits on coaxial cables, quadratic addition ($h = 2$) applies to random noise expressed in terms of r.m.s. voltage. For circuits on radio-relay links, see C.C.I.R. Recommendation 289-1.

Note 2. — Considering the probability of arithmetic addition of power-supply hum in circuits of few sections, it may be advisable to put $h = 1$ when $n \leqq 3$.

Note 3. — Considering the probability of arithmetic addition when periodic noise consists of a few components that are very close in frequency, it may be advisable to put $h = 1$, when the number of such components is small.

Note 4. — When each of a number of sources of impulsive noise is operative for a small percentage of the time (e.g. $< 0.1\%$), arithmetic addition of the percentage will apply.

Note 5. — In Canada and the United States of America, the practice is to use $h = 2$.

Note 6. — For systems D and K, the method outlined in Doc. C.M.T.T./60, 1963-1966, could be used.

Note 7. — Further information is given in Doc. C.M.T.T./49 (O.I.R.T.), 1966-1969.

3. Examples of the use of Tables 1 and 2

3.1 In the hypothetical reference circuit, if the tolerance on gain is ± 1 dB, the tolerance on gain for a video section will (with $h = 2$) be:

$$D_1 = D_3 \left(\frac{1}{3}\right)^{1/2} = D_3 \times 0.58 = \pm 0.58 \text{ dB}.$$

3.2 In the hypothetical reference circuit, if the tolerance on the signal-to-noise ratio is 50 dB, the tolerance on the signal-to-noise ratio for a 9-section circuit will be calculated as follows (with $h = 2$):

noise amplitude for the hypothetical reference circuit: D_3;

noise amplitude for the 9-section circuit:

$$D_9 = D_3 \left(\frac{9}{3}\right)^{1/2} = D_3 \times 1.73$$

signal-to-noise for the 9-section circuit:

$$\frac{S}{D_9} = \frac{S}{D_3} \times \frac{1}{1.73}$$

or, in dB: $\left(\frac{S}{D_9}\right)$ dB $= 50 - 4.8$, i.e. about 45 dB.

3.3 In the hypothetical reference circuit, if the tolerance on non-linearity is 20%, the tolerance on non-linearity for a video section will be (with $h = 3/2$):

$$D_1 = D_3 \left(\frac{1}{3}\right)^{2/3} = D_3 \times 0.48$$

$$D_1 = 20 \times 0.48 = 9.6\%.$$

Recommendation J.62 (Mar del Plata, 1968) [1]

SPECIFICATION FOR A LONG-DISTANCE TELEVISION TRANSMISSION (System I only) [2]

The C.C.I.T.T.,

considering

the agreement reached by the Joint C.C.I.R./C.C.I.T.T. Committee for television transmission (C.M.T.T.) on a draft recommendation concerning television transmission over long distances, common to the C.C.I.R. and the C.C.I.T.T.;

unanimously recommends

that, taking account of the definitions in Part 1, television transmissions over long distances for system I should satisfy the requirements laid down in Part 2 and its Annex.

The requirements for the transmission of other systems are contained in Recommendation J.61 and C.C.I.R. Report 316-1. The existence of this new Recommendation does not necessarily imply that the requirements for other systems will later be included in this Recommendation or that their requirements will be changed in form.

PART 1

DEFINITIONS

1. Definition of a long-distance international television connection (see Figure 1/J.61)

1.1 Point A, to be considered as the sending end of the international television connection, may be the point at which the programme originates (studio or outside location), a switching centre or the location of a standards converter.

[1] This Recommendation corresponds to C.C.I.R. Recommendation 451-1, Volume V(2), New Delhi, 1970.

[2] For the other systems see Recommendation J.61.

1.2 Point D, to be considered as the receiving end of the international television connection, may be a programme mixing or recording centre, a broadcasting station, a switching centre or the location of a standards converter.

1.3 The local line AB connects point A to the sending terminal station, point B, of the international television circuit.

1.4 The long-distance international television circuit, BC, comprises a chain of national and international television links. The precise locations (e.g. within buildings), to be regarded as the points B and C, will be nominated by the Administrations concerned.

1.5 The local line CD connects point C, the receiving terminal station of the long-distance international television circuit, to the point D.

1.6 The combination AD, of the long-distance international television circuit, BC, and the local lines AB and CD, constitutes the *international television connection.*

2. Definition of the hypothetical reference circuit

The main feature of the television hypothetical reference circuit, which is an example of a long-distance international television circuit (BC in Figure 1/J.61) and which may be of either radio or coaxial-cable type, are:

— the overall length between video terminal points is 2500 km (about 1600 miles);

— two intermediate video points divide the circuit into three sections of equal length;

— the three sections are lined up individually and then interconnected without any form of overall adjustment or correction;

— the circuit does not contain a standards converter or a synchronizing-pulse regenerator.

Note. — The Annex to Part 1 gives a provisional indication of the characteristics of circuits having more or fewer sections than the hypothetical reference circuit.

ANNEX

(to Part 1 of Recommendation J.62)

Circuits having more or fewer sections than the hypothetical reference circuit

1. Introduction

The purpose of this Annex is to give some indication of the design objectives of hypothetical circuits that have more or fewer video-to-video sections than the three of the hypothetical reference circuit defined in paragraph 2 of Part 1 of this Recommendation. The values calculable from Tables 1 and 2 provide only indications of the probable design objectives, which should not be used directly when studying the design of equipment because the law of addition is not precisely known for every type of impairment.

2. Laws of addition

If D_3: design objective as expressed in this Recommendation, or the parameter derived therefrom and indicated in Table 2, permitted in the hypothetical reference circuit,

and D_n: design objective, or the parameter mentioned above, permitted in n sections,

then
$$D_n = D_3 \left(\frac{n}{3}\right)^{1/h}$$

where h has the value 1, 3/2 or 2 in accordance with Table 2: $h = 1$ gives linear or arithmetic law of addition, $h = 3/2$ gives the "three-halves power" law of addition, and $h = 2$ gives quadratic (r.s.s.) addition.

Calculated values of $\left(\frac{n}{3}\right)^{1/h}$ are given in Table 1.

TABLE 1

n	$\left(\frac{n}{3}\right)^{1/h}$		
	$h = 1$	$h = 3/2$	$h = 2$
1	0.33	0.48	0.58
2	0.67	0.76	0.82
3	1.00	1.00	1.00
4	1.33	1.21	1.15
5	1.67	1.41	1.29
6	2.00	1.59	1.41
7	2.33	1.76	1.53
8	2.67	1.92	1.63
9	3·00	2.08	1.73
10	3.33	2.23	1.83
11	3.67	2.38	1.91
12	4.00	2.52	2.00
13	4.33	2.66	2.08
14	4.67	2.79	2.16
15	5.00	2.92	2.24

TABLE 2

Paragraph of Part 2	Characteristic	D_3 expressed in	h	Notes
4.1	*Insertion gain* (error)	dB	2	
4.2	*Insertion gain variations*	dB	2	
	Continuous random noise			
4.3.1	Luminance channel			1
4.3.2	Chrominance channel			1
	Periodic noise			
4.4	Power-supply hum	noise voltage	2	2
4.4	Single-frequency	noise voltage	2	3
4.5	*Impulsive noise*	noise voltage		4
4.6	*Crosstalk*	crosstalk voltage	3/2	
	Non-linear distortion of the picture signal			
4.7.1	Luminance channel	%	3/2	
	Chrominance channel			
4.7.2	Differential gain	%	3/2	
4.7.2	Differential phase	degrees	3/2	
4.8	*Non-linear distortion of the synchronizing signal*	%	3/2	
	Linear waveform distortion			
4.9.1	Luminance channel	%	3/2	
4.9.2	Chrominance channel	%	3/2	
	Luminance-chrominance inequalities			
4.10.1	Gain inequality	%	2	5
4.10.2	Delay inequality	ns	2	5
	Steady-state characteristics			
—	Attenuation/frequency			
—	Envelope-delay/frequency			

Note 1. — For circuits on coaxial cables, quadratic addition ($h = 2$) applies to random noise expressed in terms of r.m.s. voltage. For circuits on radio-relay links, see C.C.I.R. Recommendation 289-1.

Note 2. — Considering the probability of arithmetic addition of power-supply hum in circuits of few sections, it may be advisable to put $h = 1$ when $n \leqq 3$.

Note 3. — Considering the probability of arithmetic addition when periodic noise consists of a few components that are very close in frequency, it may be advisable to put $h = 1$ when the number of such components is small.

Note 4. — When each of a number of sources of impulsive noise is operative for a small percentage of the time (e.g. $< 0.1\%$), arithmetic addition of the percentage will apply.

Note 5. — Quadratic addition ($h = 2$) for gain and delay inequalities is based on the assumption that positive and negative values are made equally likely by the use of correcting networks or equivalent means.

PART 2

REQUIREMENTS FOR SYSTEM I

1. Introduction

In this Part are given the methods of testing and the limits and tolerances applicable to the hypothetical reference circuit for system I, i.e. the 625-line system having a nominal video bandwidth of 5.5 MHz.

2. Basic concepts

The requirements are based upon two concepts. The first follows from the fact that the composite colour signal may be regarded as the sum of a luminance signal (similar to a monochrome signal, including the line- and field-synchronizing pulses) and a chrominance signal (the modulated sub-carrier conveying the hue and saturation information, and the colour burst). A colour-television link may therefore be regarded as the combination of a "luminance channel" and a "chrominance channel" in overlapping frequency bands. For both specifying and testing purposes, it is convenient to deal with:

— the permissible distortion and noise impairments in these two channels taken separately;

— the permissible inequalities of gain and delay of the two channels taken in association.

The requirements for the luminance channel are assumed to be identical with those for monochrome transmission.

The second concept is based upon the consideration that it is sufficient in practice to specify and test the performance of the chrominance channel as though it were intended to carry a simple double-sideband amplitude-modulated signal. The test signals thus include sub-carrier elements modulated by waveforms chosen to suit the nominal bandwidth of the chrominance channel.

Applying these concepts to system I for the purpose of this Recommendation, the luminance-channel band is deemed to extend up to 5 MHz, and the chrominance-channel band from approximately 3.5 to 5.5 MHz, i.e. the baseband of the chrominance signal is deemed to extend up to 1 MHz. These assumptions do not imply restrictions upon the transmission of any luminance-signal components in the range 5.0 to 5.5 MHz, or chrominance-signal components below 3.5 MHz.

3. General requirements

3.1 *Impedance*

At points of video interconnection, the input and output impedance of each link should be unbalanced to earth with a nominal value of 75 Ω resistive and a return loss of at least 30 dB relative to 75 Ω.

The conventional frequency-domain interpretation of this requirement is that the return loss should be at least 30 dB at any frequency within the video band. A time-domain interpretation is, however, more convenient and useful because the technique of measurement is simpler and the results are more directly related to the picture impairments caused by mismatched impedances. The "waveform return loss", as it may be termed, is measured with a television-type test signal and the result is taken as the ratio, expressed in dB, of the peak-to-peak voltages of the "picture" portions of the incident and reflected waveforms. This result is numerically the same as the conventional one if the return loss is independent of frequency. Provisionally, it is required that the waveform return loss, relative to 75 Ω, shall be at least 30 dB when measured with each of the test signals shown in Figures 1/J.62, 2/J.62 and 4/J.62.

3.2 *Polarity and d.c. component*

At points of video interconnection, the polarity of the signal should be "positive", i.e. such that black-to-white transitions are positive-going.

The useful d.c. component, which is related to the average luminance of the picture, may or may not be contained in the signal and need not be transmitted or delivered at the output.

Any non-useful d.c. component unrelated to the signal (e.g. the component due to d.c. supplies) should not cause more than 100 mW to be dissipated in a 75 Ω load impedance. If the load impedance is disconnected, the voltage of this component should not exceed 5 V.

3.3 *Signal amplitude*

At points of video interconnection, the nominal peak-to-peak amplitude of the picture luminance signal, between blanking level and white level, should be 0.7 V, and the nominal amplitude of the synchronizing pulses should be 0.3 V. The nominal peak-to-peak amplitude of the video signal is thus 1.0 V although it is recognized that this value may occasionally be exceeded during transmission of colour signals.

4. Transmission performance requirements

4.1 *Insertion gain*

Insertion gain should be measured under the following conditions. At the sending end, a 75 Ω generator of the $2T$ pulse-and-bar test signal shown in Figure 1/J.62 should be adjusted so that, if connected directly to a 75 Ω load, the bar amplitude would be 0.7 V and the synchronizing pulse amplitude 0.3 V. The sine-squared pulse is ignored in this application. At the receiving end, the bar amplitude (between the points A and B shown in Figure 10/J.62) should be measured with a 75 Ω oscilloscope. The ratio, expressed in dB, of this amplitude to 0.7 V is taken as the insertion gain.

After initial or routine adjustment, the insertion gain should be within the limits 0 ± 0.5 dB.

4.2 *Variations in the insertion gain*

Any variations of insertion gain with time should not exceed the following limits:

— short-period variations (e.g. 1 s) ± 0.2 dB;

— medium-period variations (e.g. 1 h) ± 0.5 dB.

Long-period variations are not specified because they would generally be corrected by the normal routine adjustments.

The foregoing refers only to insertion gain as defined in paragraph 4.1. When considering variations of gain with time, the permissible limits of luminance-chrominance gain inequality given in paragraph 4.10.1 should not be overlooked.

4.3 *Continuous random noise*

The signal-to-weighted noise ratio for continuous random noise is defined as the ratio, expressed in dB, of the nominal peak-to-peak amplitude of the picture luminance signal to the r.m.s. amplitude of the noise measured under the following conditions:

— the noise is passed through a specified bandpass filter to delimit the effective frequency range, and also through a specified weighting network, or equivalent;

— the measurement is made with an instrument having, in terms of power, an effective time constant or integrating time of 1 s.

4.3.1 *Luminance channel*

The nominal frequency range is 10 kHz to 5 MHz. The lower limit is determined by the high-pass member of the junction filter shown in Figure 6/J.62, its purpose is to exclude power-supply hum and microphony noise. The upper limit is determined by the low-pass filter shown in Figure 7/J.62. The weighting network is shown in Figure 8/J.62; it has a time constant of 200 ns giving a weighting effect of 6.5 dB for flat random noise and 12.3 dB for triangular random noise.

The signal-to-weighted noise ratio should not fall below 52 dB for more than 1% of any month nor below 44 dB for more than 0.1% of any month.

4.3.2 *Chrominance channel*

The nominal frequency range is 3.5 to 5.5 MHz, determined by the combined bandpass filter and weighting network shown in Figure 9/J.62. For each sub-carrier sideband, the filter provides a weighting effect which is approximately equal to that of the luminance weighting network in the 0 to 1 MHz band.

The signal-to-weighted noise ratio should not fall below 46 dB for more than 1% of any month nor below 38 dB for more than 0.1% of any month.

4.4 *Periodic noise*

The signal-to-noise ratio for periodic noise is defined as the ratio, expressed in dB, of the nominal peak-to-peak amplitude of the picture luminance signal to the peak-to-peak amplitude of the noise.

For power-supply hum including lower-order harmonics, the signal-to-noise ratio should not be less than 35 dB. The measurement is made through the low-pass member of the junction filter shown in Figure 6/J.62.

For single-frequency noise between 1 kHz and 5.5 MHz, the signal-to-noise ratio should not be less than 55 dB.

4.5 *Impulsive noise*

The signal-to-noise ratio for impulsive noise is defined as the ratio, expressed in dB, of the nominal peak-to-peak amplitude of the picture luminance signal to the peak-to-peak amplitude of the noise.

For impulsive noise of a sporadic or infrequently-occurring nature, the signal-to-noise ratio should not be less than 25 dB.

4.6 *Crosstalk*

Crosstalk between two circuits is measured with a specified video test signal applied to the input of the disturbing circuit and an oscilloscope at the output of the disturbed circuit, which is otherwise quiescent. The signal-to-crosstalk ratio is defined as the ratio, expressed in decibels, of the nominal peak-to-peak amplitude of the picture luminance signal on the peak-to-peak amplitude of the "picture" portion of the crosstalk waveform.

At present, definitive limits can be specified only for two particular cases; for other forms of crosstalk further study is required. The specifications given in the two following paragraphs are strictly applicable only when the disturbing circuit, as well as the disturbed circuit, is designed to transmit system I signals, but they may serve as a guide under comparable conditions of service with other systems.

If the crosstalk is substantially undistorted, the signal-to-crosstalk ratio should not be less than 58 dB when measured with the test signal shown in Figure 1/J.62 applied to the disturbing circuit.

If the crosstalk is substantially "differentiated" (i.e. crosstalk voltage proportional to frequency), the signal-to-crosstalk ratio should not be less than 50 dB when measured with the test signal shown in Figure 4/J.62 applied to the disturbing circuit.

4.7 *Non-linear distortion of the picture signal*

Line-time non-linearity distortions in the luminance and chrominance channels are measured with the test signal shown in Figure 3/J.62, consisting of a 5-riser staircase, with superimposed sub-carrier, in every fourth line. Separate measurements are made with the three intermediate lines at black level and white level, and the higher value of distortion is taken as the result.

4.7.1 *Luminance channel*

At the receiving end, the test signal is passed through a differentiating and shaping network (see Doc. C.M.T.T./3, Monte Carlo, 1958), whose effect is to eliminate the sub-carrier and transform the staircase into a train of 5 pulses of approximately sine-squared shape with 2 µs half-amplitude duration. Comparing the amplitudes of the pulses, the numerical value of the distortion is found by expressing the difference between the largest and smallest amplitude as a percentage of the largest.

The distortion should not exceed 12%. In addition, when the test signal is sent at 3 dB above normal amplitude (i.e. 1.4 V peak-to-peak), the distortion should not exceed 24%.

4.7.2 *Chrominance channel*

At the receiving end, the sub-carrier is filtered from the rest of the test signal and its six sections are compared in amplitude and phase. Taking the blanking-level section of the sub-carrier as reference, the differential gain is defined as the largest departure from the reference amplitude, expressed as a percentage, and the differential phase is defined as the largest departure from the reference phase-angle, expressed in degrees. (It seems desirable to seek a method of deriving numerical values which are more closely related to picture impairment.)

Provisionally, the differential gain should not exceed $\pm 8\%$, and the differential phase should not exceed $\pm 4°$. In addition, when the test signal is sent at 3 dB above normal amplitude, the distortions should not exceed $\pm$ 16% and $\pm$ 8° respectively.

4.8 *Non-linear distortion of the synchronizing signal*

The distortion is expressed in terms of percentage departure of the mid-point amplitude of the line-synchronizing pulse from its nominal amplitude, i.e. 0.3 V for a circuit having zero insertion gain as defined in paragraph 4.1. Using the staircase test signal shown in Figure 3/J.62, separate measurements are made with the three intermediate lines at black level and white level, and the higher value of distortion is taken as the result.

The distortion should not exceed $\pm 10\%$. In addition, when the test signal is sent at 3 dB above normal amplitude, the distortion should not exceed $\pm 20\%$.

4.9 *Linear waveform distortion*

4.9.1 *Luminance channel*

The short-time, line-time and field-time linear distortions in the luminance channel are found from the waveform responses to the pulse-and-bar and 50 Hz square-wave test signals shown in Figures 1/J.62 and 2/J.62. The result is expressed as a rating factor K by the method described in the Annex to Part 2.

The rating factor should not exceed 3%.

4.9.2 *Chrominance channel*

The short-time and line-time linear distortions in the chrominance channel are found from the waveform responses to the pulse-and-bar modulated sub-carrier test signal shown in Figure 4/J.62.

The result may be expressed by a rating factor analogous to that of the luminance channel but a limit cannot be proposed until more experience has been gained.

4.10 *Luminance-chrominance inequalities*

Gain and delay inequalities between the luminance and chrominance channels are measured with the composite test signal shown in Figure 5/J.62. It consists essentially of added luminance and chrominance signal elements which are equal in single-peak amplitude and coincident in time. At the receiving end, two calibrated variable networks are adjusted to annul any inequality of amplitude or delay.

4.10.1 *Gain inequality*

The gain inequality, expressed as the percentage departure of the amplitude of the chrominance element from the amplitude of the luminance element, both measured at the mid-point of the bar, should not exceed $\pm 10\%$.

4.10.2 *Delay inequality*

The delay inequality should not exceed ± 100 ns.

ANNEX

(to Part 2 of Recommendation J.62)

Linear waveform distortion, luminance channel

1. Introduction

This Annex describes two complementary methods of specifying the linear transmission performance of a luminance channel. The first, or "routine-test method", is rapid but less precise because it relies on direct oscilloscopic observation of the responses to prescribed test signals, and because the spectrum of one of these signals unavoidably extends beyond the nominal 5 MHz limit of interest. The second, or "acceptance-test method", is slow but more precise because a process of computation applied to a series of waveform ordinates enables irrelevant information to be eliminated and certain measuring equipment errors to be corrected.

The performance limits are given in terms of a rating factor, K, for which numerical values are assigned in the individual specifications of links and equipment. Rating factors may range from 0.5% ($K = 0.005$) for a short-distance link up to several per cent for a chain of long-distance links.

2. Routine-test method

To meet a specified rating factor, K, the responses to the pulse-and-bar and 50 Hz square-wave test signals shown in Figures 1/J.62 and 2/J.62 should fall within the following limits.

2.1 *2T bar response*

The limits are indicated by the oscilloscope mask shown in Figure 10/J.62. In effect, the oscilloscope is to be adjusted so that the half-amplitude points of the bar transition coincide with M_1 and M_2, and the mid-points of the $H/2.5$ "black" and "white" portions coincide with A and B respectively. The response should then fall within the $\pm K$ limits indicated by the full lines, which extend to $H/100$ from the half-amplitude point of each transition.

2.2 *2T pulse response*

The limits are indicated by the oscilloscope mask shown in Figure 11/J.62. In effect, the oscilloscope is to be adjusted so that:

— the sweep velocity corresponds with the time scale indicated;

— the "black" level of the response coincides with the horizontal axis;

— the peak of the response falls on the unit-amplitude line;

— the half-amplitude points of the response are symmetrically disposed about the vertical axis.

2.3 *2T pulse/bar ratio*

The ratio of the amplitude of the $2T$ pulse response to the amplitude of the $2T$ bar response should fall within the limits $1/(1 \pm 4\ K)$, where the pulse amplitude is the difference between the "black" level and the peak of the response, and the bar amplitude is the difference between the points A and B already defined. The limits are included in the mask shown in Figure 10/J.62.

2.4 *T pulse response*

To meet the luminance-channel requirements, the T pulse response should not show appreciable ringing at a frequency below 5.0 MHz, irrespective of the assigned rating factor. This is only of academic interest for system I because the chrominance-channel requirements are such that the ring frequency should not be less than 5.5 MHz.

Other limits cannot be specified rigidly because the spectrum of the T pulse extends far beyond 5 MHz, and the response must therefore contain irrelevant information. A partial solution is found in the insertion of a "5.3 MHz link filter" between the link and the oscilloscope. This is a member of a series of delay-equalized low-pass filters designed to have good waveform responses; its insertion loss is almost constant up to 5.0 MHz, thence increases by about 3 dB at 5.3 MHz (the ring frequency) and 20 dB at 5.7 MHz. Being dominant in determining the overall upper cut-off characteristic, it substantially attenuates the irrelevant components of the response. The T pulse/bar ratio of the overall response is then a useful feature for measurement; it is closely related to the ratio which forms the basis of restriction (3) in the acceptance-test method (paragraph 3.2).

It has been found empirically that, to meet a specified rating factor, K, the T pulse/bar ratio of the link plus filter should fall within the limits $0.84/(1 \pm 6\ K)$. Thus, for a rating factor of 1%, the ratio should be between 79% and 89%. As the formula indicates, a ratio of 84% is given by the filter alone.

Other features of interest in the T pulse response of the link plus filter are the lobes of ringing immediately before and after the main lobe of the response. The following is a rough guide to the maximum amplitudes to be expected under normal conditions:

Lobe	Upper limit of lobe amplitude expressed as percentage of bar amplitude	
	$K = 1\%$	$K = 5\%$
First lobe (negative), leading or trailing	12	20
Second lobe (positive), leading or trailing	8	12

Although the amplitudes of other lobes may be of importance in some cases, it is not possible to offer further general guidance at present.

2.5 *50 Hz square-wave response*

The limits are indicated by the oscilloscope mask shown in Figure 12/J.62. As for the $2T$ bar response, the oscilloscope is to be adjusted so that the waveform passes through the four marked points, the line-synchronizing pulses being ignored.

3. Acceptance-test method

3.1 *2T bar response*

The limits are identical with those given in paragraph 2.1 for the routine-test method.

3.2 *T pulse response*

From the measured T pulse response and the measured or assumed response of the measuring equipment itself, the "filtered impulse response" is derived and expressed in the form of a normalized time series [see N. W. Lewis, *Proc. I.E.E.*, Vol. 101, Part III (1954)]. The "main" term of this series represents the ideal or non-distorting part, and the "echo" terms represent the distorting part. To meet a specified rating factor, K, the amplitudes of the echo terms should be such that each of the following four restrictions is met.

Let the time series representing the filtered impulse response be

$$B(rT) = \dots B_{-r}, \dots\dots\dots B_{-1}, B_0, B_{+1} \dots\dots B_{+r}, \dots$$

and assume that this has already been normalized so that $B_0 = 1$.

Let the serial product of $B(rT)$ and the series [½, 1, ½] be

$$C(rT) = \dots C_{-r}, \dots C_{-1}, C_0, C_{+1}, \dots\dots\dots C_{+r}, \dots\dots\dots$$

where $C_r = \tfrac{1}{2}B_{r-1} + B_r + \tfrac{1}{2}B_{r+1}$

Restriction (1) is then given by

$$\frac{1}{8}\left|\frac{C_r}{C_0} - \frac{1}{2}\right| \leqq K \qquad r = \pm 1$$

and

$$\frac{1}{8}\left|r\,\frac{C_r}{C_0}\right| \leqq K \qquad \begin{cases} -8 \leqq r \leqq -2 \\ +2 \leqq r \leqq +8 \end{cases}$$

and

$$\left|\frac{C_r}{C_0}\right| \leqq K \qquad \begin{cases} r \leqq -8 \\ +8 \leqq r \end{cases}$$

Restriction (2) is given by

$$\frac{1}{4}\left|\left(\frac{1}{C_0}\sum_{-8}^{+8} B_r\right) - 1\right| \leqq K$$

Restriction (3) is given by

$$\frac{1}{6}\left|\left(\sum_{-8}^{+8} B_r\right) - 1\right| \leqq K$$

Restriction (4) is given by

$$\frac{1}{20}\left\{\left(\sum_{-8}^{+8} \left|B_r\right|\right) - 1\right\} \leqq K$$

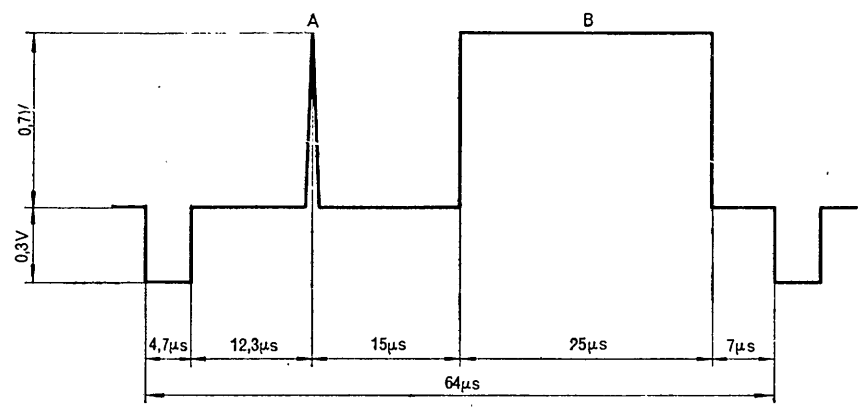
The series $C(rT)$ represents fairly closely the response to a $2T$ pulse. Restriction (1) is thus approximately equivalent to the limits indicated in Figure 11/J.62 for the $2T$ pulse response in the routine-test method. Restriction (2) is similar to the limits placed on the $2T$ pulse/bar-ratio in the routine-test method. Restriction (3) is equivalent to limits placed on the pulse/bar-ratio of the response to a hypothetical pulse-and-bar test signal in which the pulse is an ideal filtered impulse. Restriction (4) is an upper limit placed on the average amplitude, ignoring signs, of the 16 central echo terms.

3.3 *50 Hz square-wave response*

The limits are identical with those given in paragraph 2.5 for the routine-test method.

4. Gain/frequency characteristic

As a precaution against possible overloading effects, the insertion gain at any frequency between 50 Hz and 5 MHz should not exceed the gain at the line-repetition frequency by more than an amount in dB numerically equal to the percentage rating factor, e.g. 1 dB for a rating factor of 1% ($K = 0.01$).

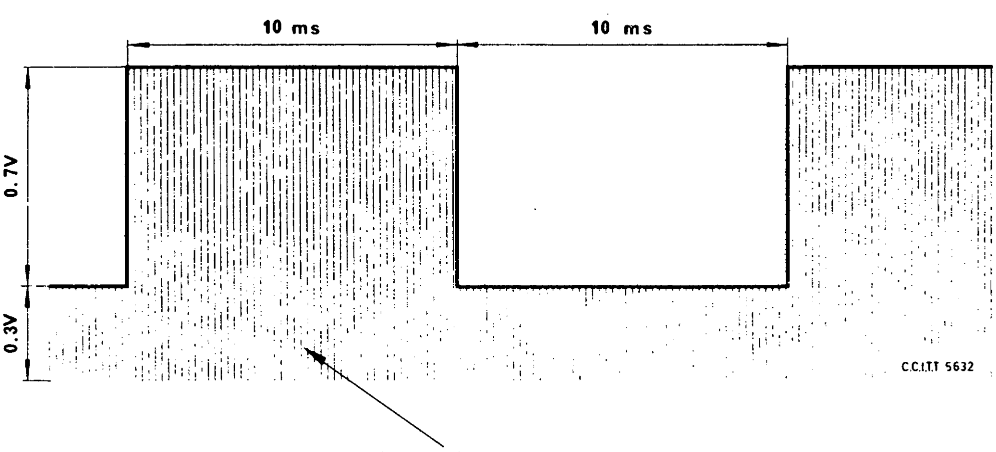


(For insertion gain, and short-time and line-time linear distortions in the luminance channel)

A: T pulse or $2T$ pulse
B: T bar or $2T$ bar
$T = 100$ ns

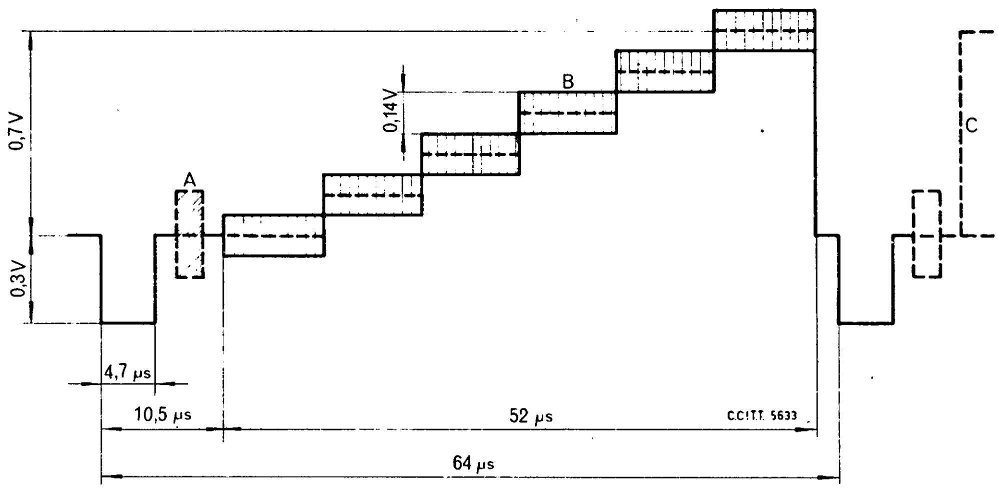
FIGURE 1/J.62. — ***T* and 2*T* pulse-and-bar test signals**

Note. — For the design of the shaping-network, see MACDIARMID and PHILLIPS, *Proc. I.E.E.*, Vol. 105B, 440 (1958).



(For field-time linear distortion in the luminance channel)

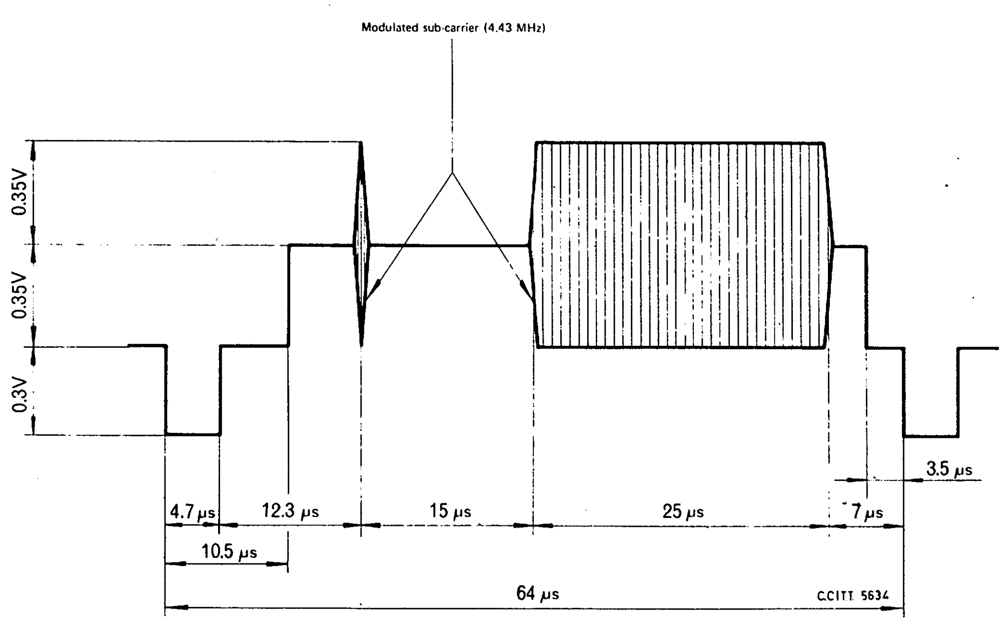
FIGURE 2/J.62. — **50 Hz square-wave test signal**



(For all non-linear distortions)

A: Optional colour burst
B: Superimposed sub-carrier (4.43 MHz)
C: 3 lines at black level or 3 lines at white level

FIGURE 3/J.62. — **Staircase test signals**

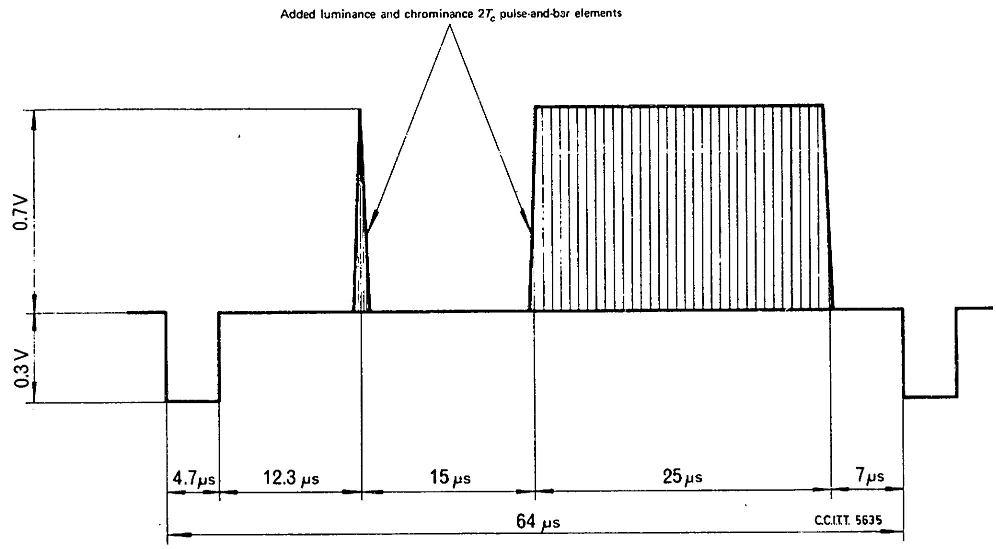


(For short-time and line-time linear distortions in the chrominance channel)

$T_c = 500$ ns

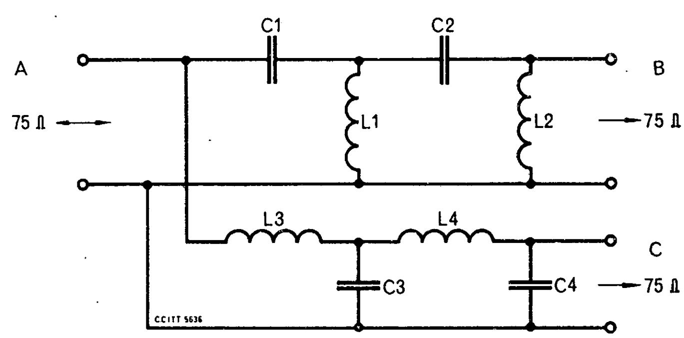
FIGURE 4/J.62. — **T_c and $2T_c$ pulse-and-bar test signals**

Note. — For the design of the shaping-network, see MacDiarmid and Phillips, *Proc. I.E.E.*, Vol. 105B, 440 (1958).



(For luminance-chrominance gain and delay inequalities)
$T_c = 500$ ns

FIGURE 5/J.62. — **Composite test signal**



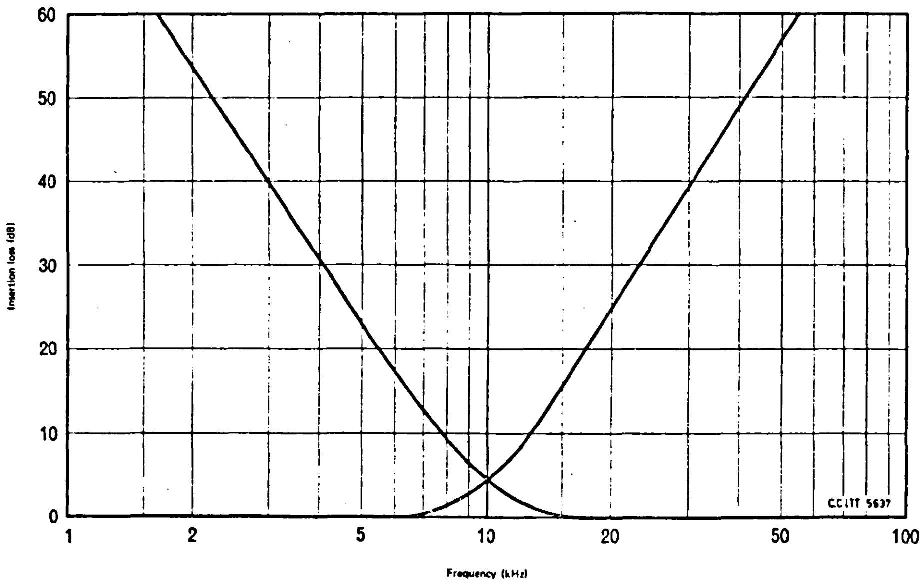
A: Input
B: High-pass output
C: Low-pass output

TABLE OF VALUES

Component	Value	Tolerance
C1	139 000	±5%
C2	196 000	
C3	335 000	
C4	81 200	
L1	0.757	±2%
L2	3.12	
L3	1.83	
L4	1.29	

Note 1. — Inductances are given in mH, capacitances in pF.

Note 2. — The *Q*-factor of each inductor should be equal to, or greater than, 100 at 10 kHz.



(For noise measurement)

FIGURE 6/J.62. — **Junction filter**

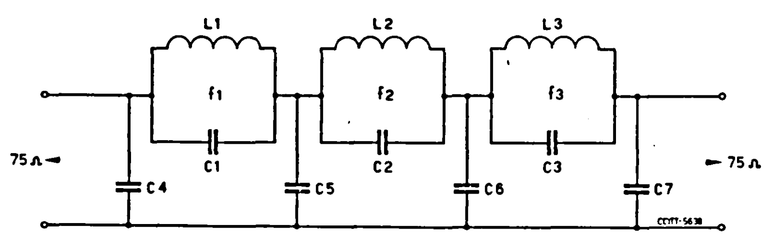


TABLE OF VALUES

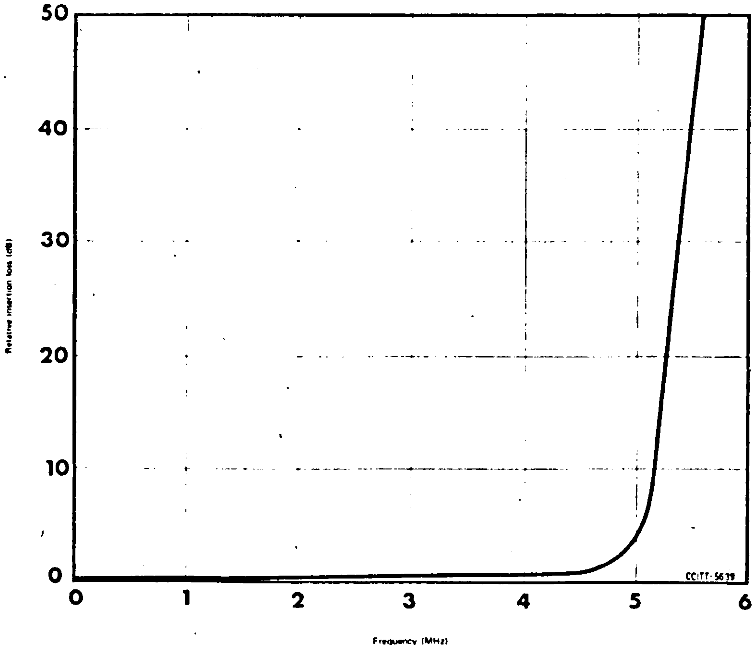
Component	Value	Tolerance
C1	100	Note 2
C2	545	
C3	390	
C4	428	
C5	563	
C6	463	
C7	259	
L1	2.88	Note 3
L2	1.54	
L3	1.72	
f_1	9.408	
f_2	5.506	
f_3	6.145	

Note 1. — Inductances are given in μH, capacitances in pF, frequencies in MHz.

Note 2. — Each capacitance quoted is the total value, including all relevant stray capacitances, and should be correct to $\pm 2\%$.

Note 3. — Each inductor should be adjusted to make the insertion loss a maximum at the appropriate indicated frequency.

Note 4. — The *Q*-factor of each inductor measured at 5 MHz should be between 80 and 125.



(For random noise in the luminance channel)

FIGURE 7/J.62. — Low-pass filter

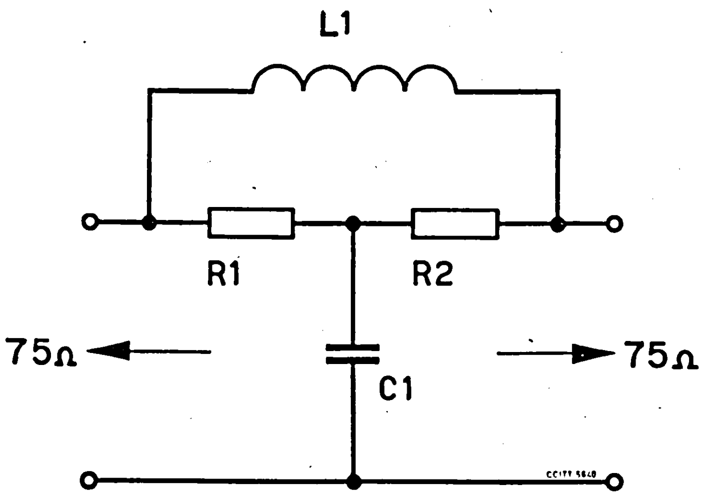


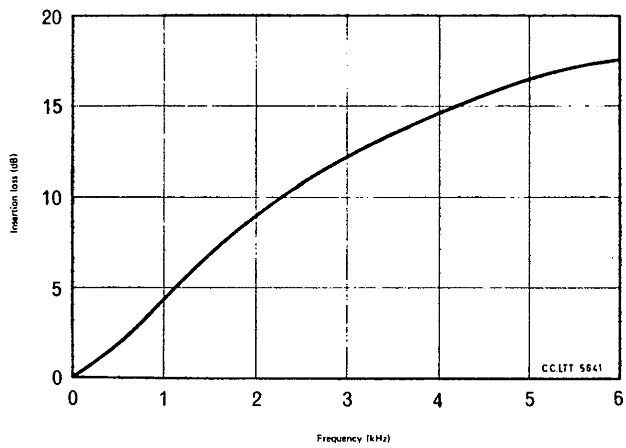
TABLE OF VALUES

Component	Value	Tolerance
C1	2660	±1 %
L1	15	
R1	75	
R2	75	

Note 1. — Inductance is given in μH, capacitance in pF, resistance in ohms.

Note 2. — The *Q*-factor of inductor L1 should be equal to, or greater than, 25 at 8 MHz.

Note 3. — Insertion loss = 10 $\log_{10}$ $[1 + (2\pi\tau f)^2]$ dB, where τ = 200 ns.



(For random noise in the luminance channel)

FIGURE 8/J.62. — **Weighting network**

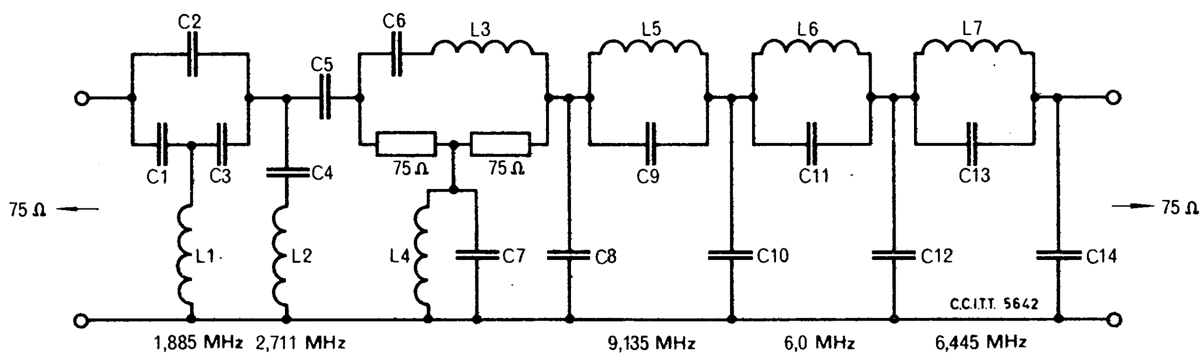


TABLE OF VALUES

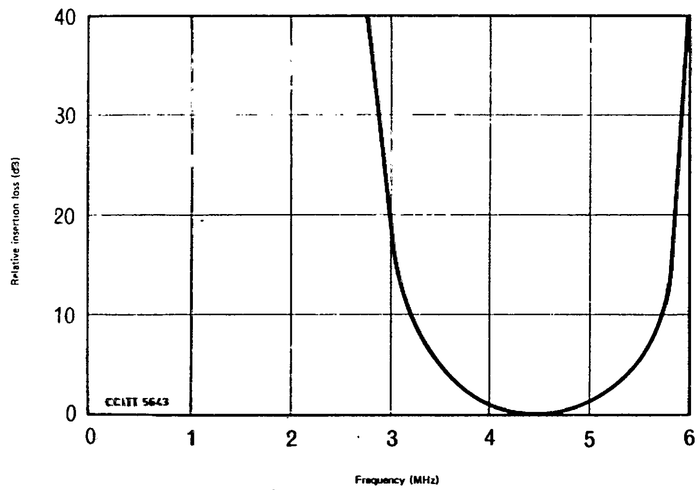
Component	Value	Tolerance	Component	Value	Tolerance
C1	496.0		C12	311.4	
C2	89.47		C13	619.2	± 1%
C3	292.1		C14	187.5	
C4	715.8		L1	2.960	
C5	1239.0		L2	4.814	
C6	194.3	± 1%	L3	6.650	
C7	1182		L4	1.093	Note 2
C8	385.7		L5	2.149	
C9	141.3		L6	0.7476	
C10	418.6		L7	0.9846	
C11	941.2				

Note 1. — Inductances are given in μH, capacitances in pF.

Note 2. — L3 is adjusted to resonate with C6, and L4 with C7 at 4.428 MHz. L1, L2, L5, L6 and L7 are adjusted to give maximum insertion loss at the appropriate indicated frequencies.

Note 3. — The *Q*-factor of each inductor should be equal to, or greater than, 100 between 3 MHz and 6 MHz.

Note 4. — The insertion loss is equal to, or greater than, 35 dB at frequencies above 6 MHz.



(For random noise in the chrominance channel)

FIGURE 9/J.62. — **Band-pass filter and weighting network**

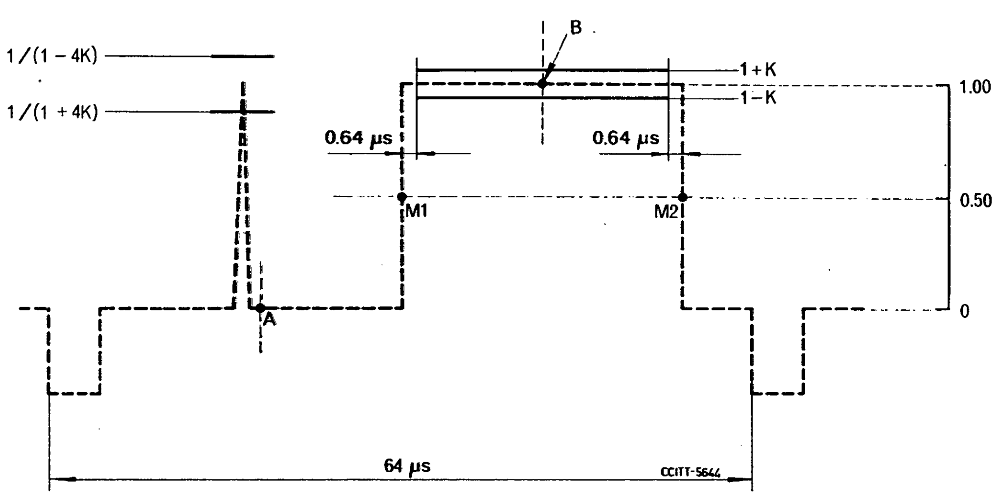
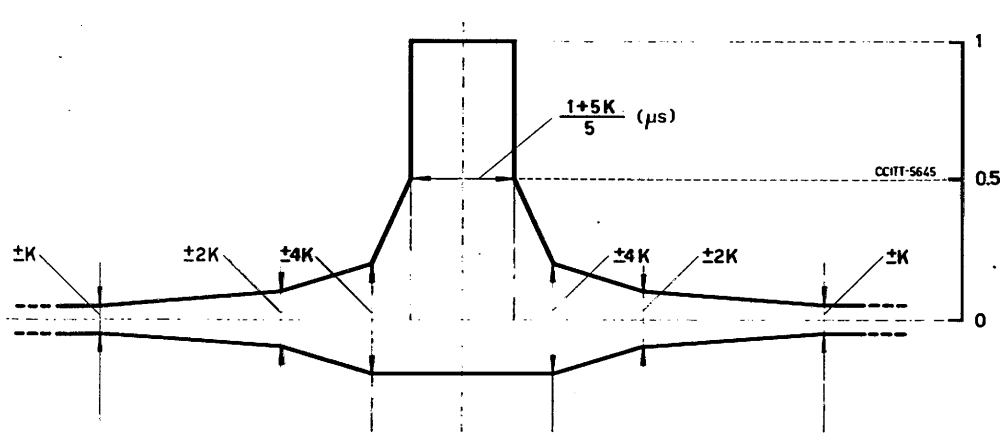


FIGURE 10/J.62. — ***2T* bar response and *2T* pulse/bar ratio**



Unit interval: 100 ns

FIGURE 11/J.62. — ***2T* pulse response**

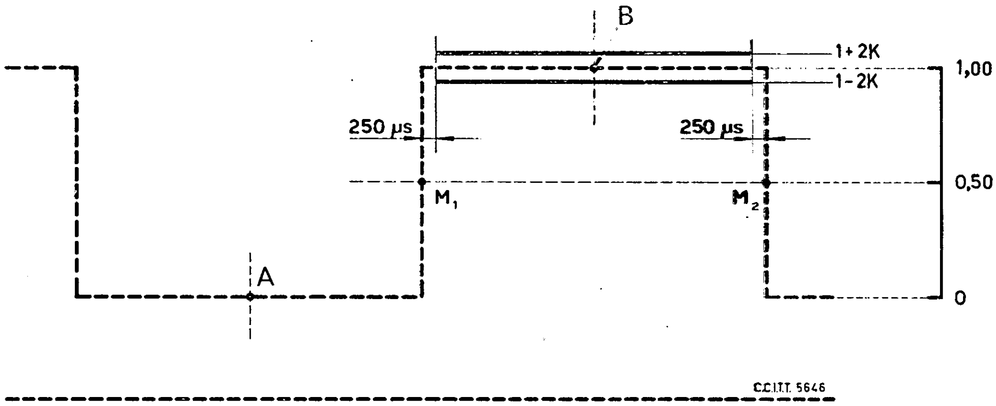


FIGURE 12/J.62. — **50 Hz square-wave response**

SECTION 7

GENERAL CHARACTERISTICS OF SYSTEMS FOR TELEVISION TRANSMISSION OVER METALLIC LINES AND INTERCONNECTION WITH RADIO-RELAY LINKS

Recommendation G.331 gives details of the 2.6/9.5-mm type of coaxial cable standardized by the C.C.I.T.T.

Recommendations have also been made by the C.C.I.T.T. concerning the following systems for transmitting television signals over such pairs:

— 4-MHz system, which can be used to transmit 405-line television (Recommendation J.71);

— 6-MHz system, for transmitting 625-line television (5 MHz video-frequency band) or the Belgian 819-line system (Recommendation J.72);

— 12-MHz system, which can be used to transmit telephony and television simultaneously (Recommendation J.73).

Recommendation J.71

4-MHz SYSTEM FOR TELEVISION TRANSMISSION

The 4-MHz coaxial cable system, defined in Recommendation G.337, can be used for transmitting 405-line television signals. For this it is recommended that the following conditions be met:

a) *Carrier frequency and sidebands*

It is unanimously recognized that the use of a method of transmission with a vestigial sideband is necessary for the type of television transmission considered. It is assumed that the video signal to be transmitted corresponds to an image consisting of 405 lines and that at the studio output the spectrum of the video signal has a relatively sharp cut-off at the two extremities, these being respectively 30 Hz and 3 MHz. It is also assumed that the originating broadcast authority has corrected as far as possible for aperture distortion and other distortions in the camera chain.

With a coaxial cable of the type standardized by the C.C.I.T.T. (see Recommendation G.331) and with a repeater spacing of the order of 9 kilometres (used for 4-MHz telephone carrier systems [1] on coaxial cable of this type), it is possible to transmit an upper sideband of width around 3 MHz and a vestigial lower sideband of width 500 kHz (value considered satisfactory provisionally even though there is not yet sufficient experience on this subject). If the construction of the cable has been of high quality as regards the regularity of impedance and if the equalization and phase compensation has been good, it may be assumed that the signal applied at the input will be faithfully reproduced at the output.

[1] See Recommendation G.338.

For television transmissions of the type considered it is recommended to employ in Europe a carrier frequency of nominal value 1056 kHz, it being understood that, during a transmission, the carrier frequency should not change by more than a few hertz.

In the present state of the technique, it is not yet possible to design transmitting and receiving terminal equipments independently of each other.

b) *Polarity of modulation*

The advantages or disadvantages of positive polarity (where the signal increases with the brilliance) or negative polarity have not yet been established for television transmissions on metallic lines, but, on the other hand, it is desirable not to have to use inversion apparatus at the interconnection of two circuits. Hence it is recommended that the polarity of modulation adopted at the origin of a chain for international television transmission should be conserved throughout the length of this chain.

c) *Ratio of amplitude between vision and synchronizing signal*

It is recommended that the ratio:

$$\frac{\text{amplitude of vision signal}}{\text{amplitude of synchronizing signal}}$$

in the modulated wave should equal $\frac{7}{3}$.

d) *Depth of modulation*

The limit allowed for the "reference modulation coefficient" defined below is provisionally fixed at 50%.

Note. — The modulation coefficient, for a given signal s, is defined as follows: V_s is the voltage (peak-to-peak) of the video signal considered. This signal amplitude modulates a carrier, the amplitude of which varies between the two limits V_M and V_m with $V_M - V_m = V_s$ when the two sidebands are retained.

By definition, the modulation coefficient τ is

$$\tau = \frac{V_s}{V_M + V_m} = \frac{V_M - V_m}{V_M + V_m}$$

It will be seen that this definition coincides with the usual definition when the signal s is sinusoidal.

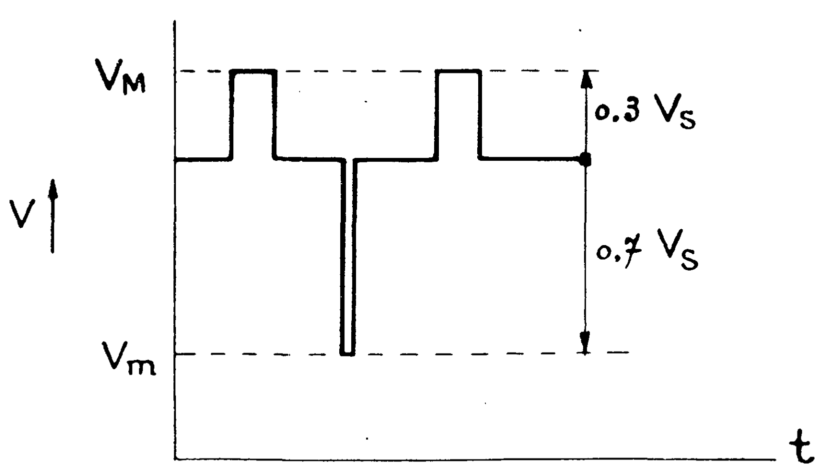


FIGURE 1/J.71

After partial suppression of the lower sideband, the amplitude ratios considered above are approximately retained and the modulation coefficient

$$\tau = \frac{V_M - V_m}{V_M + V_m}$$

remains for all intents and purposes the same.

The modulation coefficient defined above is essentially a function of the type of signal transmitted and differs according to whether the d.c. component of a video signal is retained or not.

However, there should be a limit to the highest modulation coefficient that it is possible to meet amongst all the possible types of waveform in order to limit the detection distortion which appears due to the partial suppression of the lower sideband.

The choice of this highest modulation coefficient determines the modulation coefficient for all other types of signal.

Also, the maximum amplitude of the modulated carrier that it is possible to meet should have an upper limit in order to limit the non-linear distortion. The ratio between the vision signal and the basic noise is then so much smaller that the modulation coefficient is itself small. It would appear from this that there should be a lower limit to the modulation coefficient. The choice is therefore a compromise between the two requirements.

When the complete video signal is as defined above (with, for example, a negative polarity of modulation) and the d.c. component has been suppressed, it is easy to determine the type of video signal corresponding to the higher coefficient of modulation. It is that which corresponds to the transmission of white spots on a dark background (Figure 1/J.71) (it might be considered that the average value of the synchronizing signal is negligible compared with V_s).

The corresponding coefficient of modulation τ_R is called "the reference coefficient of modulation".

e) *D.c. component*

It is recommended that the d.c. component of the complete video signal should be suppressed for transmission to line.

f) *Repeater input and output impedance*

The return loss between repeater input and output impedances and a pure resistance of 75 ohms should be at least 20 dB at the carrier frequency used for television; the limit permitted for such return loss may decrease progressively to 15 dB at the upper and lower edges of the band of frequencies transmitted for monochrome television.

Note 1. — This being so, at the 1056-kHz carrier frequency and at adjacent frequencies, the overall resultant value of echo in a single repeater section of normal length (sum of the three terms as defined in the Annex to Recommendation J.73) that is obtained is considerably better than the value of 70 dB recommended. The value of 70 dB is, in fact, easily achieved throughout the transmitted band in the case of the 4-MHz system, except at the lower limit of the vestigial sideband, say from 0.5 to 0.7 MHz. A lower figure is in any case acceptable here, as the energy of the signal is small at these frequencies.

Note 2. — The C.C.I.T.T. considered it unnecessary for it to specify other repeater characteristics. For the time being, the arrangements in the case of a cable crossing a frontier should be the subject of bilateral agreement between the countries concerned. (See Recommendation G.352 for the comparable case on telephony on a 2.6/9.5-mm type coaxial cable crossing a frontier.)

Recommendation J.72

6-MHz SYSTEM FOR TELEVISION TRANSMISSION

The 6-MHz coaxial cable system, defined in Recommendation G.337, is normally used for transmitting 625-line television signals (with a 5-MHz video-frequency band) or the 819-line Belgian system. It is then recommended that the following conditions be met:

a) *Characteristics at intermediate distribution points*

Interconnection between different high-frequency lines or between lines and television modulating or demodulating equipments should only be made at points corresponding to B and E in Figure 1/J.72, which might be called "television carrier-frequency interconnection points". (In the same way, points B′ and E′ are "telephony carrier-frequency interconnection points" when telephone channels have to be transmitted to line.) At such interconnection points, the line pilots are suppressed, and the gain/frequency characteristic between points B and E (or B′ and E′) is a horizontal straight line throughout the transmitted frequency band, since networks N_1 and N_2 (or N'_1 and N'_2) have compensating inverse characteristics. It is not necessary to specify the characteristics of these networks precisely, since they depend on the particular line system used for the high-frequency line, CD.

The impedance of the input and output circuits corresponding to points B and E in Figure 1/J.72 must be specified. The recommended value is 75 ohms unbalanced to earth and the return loss against a pure 75-ohm resistance should not be less than 24 dB.

When it is necessary, as an alternative, to insert pre-emphasis and de-emphasis networks, N'_1 and N'_2, the 6-MHz line, CD, can be used alternatively for television or telephony, under the conditions given in Section B of Recommendation G.337.

Note. — So that two line-systems made by different manufacturers can be interconnected at an intermediate point, such as a frontier repeater station, it is first necessary to correct for pre-emphasis (produced, for example, by network N_1 of Figure 1/J.72) by means of an inverse network (such as N_2 of Figure 1/J.72) and thus to create a point similar to E. Between B and E the line has a gain/frequency characteristic which is a horizontal straight line.

b) *Carrier frequency*

The nominal frequency of the video-signal carrier should be 1056 kHz with a tolerance of ± 5 Hz.

c) *Modulation coefficient*

Amplitude modulation should be used. The modulation coefficient should be greater than 100% (as shown in Figure 2/J.72) so that when the carrier is modulated by a signal at suppression level the amplitude of this signal should equal that of the carrier modulated by white level (assuming that the d.c. component is transmitted).

When Test Signal No. 2 (see Annex I to Recommendation J.61) is sent to the modulated input (point A in Figure 1/J.72), the nominal value of the peak voltage of the modulated carrier at the output of the

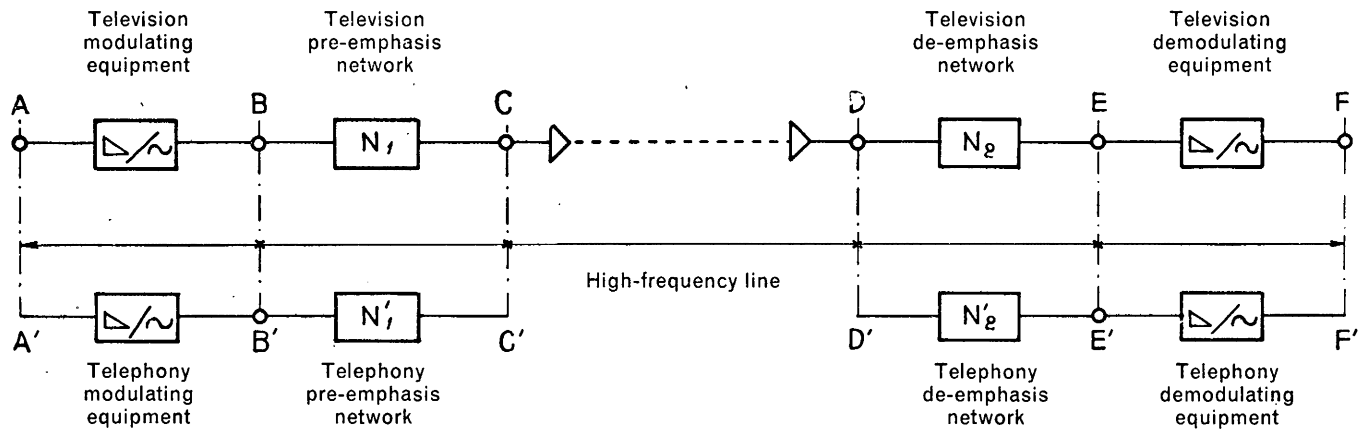


FIGURE 1/J.72. — **System of vestigial-sideband television transmission on coaxial cable**

Notes: 1. Points A and F are video interconnection points.
Points B and E are television interconnection points at carrier frequency.
Points B′ and E′ are telephony interconnection points at carrier frequency.

2. The modulator characteristics should be defined between the points A and B.
The demodulator characteristics should be defined between the points E and F.

3. Between B E and B′ E′ the gain/frequency characteristic at the high frequency is uniform.

4. The networks N_1, N_2, etc., should be chosen to facilitate the matching to the line and to present to the modulation and demodulation equipment standard level conditions, etc.

5. If a number of high-frequency lines of different types are interconnected or if derivations are made at an intermediate point, pre-emphasis and de-emphasis networks, etc., will be necessary at junction points to enable the interconnection to be made at a point of defined level and independent of frequency.

6. For alternative telephony and television transmissions, switching should be carried out at points C and D.

modulating equipment (point B in Figure 1/J.72) and at the input to the demodulating equipment (point E in Figure 1/J.72) should be as follows (see Figure 2/J.72):

— white level or suppression level, 0.387 volt—i.e. the peak value of a sinusoidal signal dissipating 1 mW in a 75-ohm resistance;

— synchronizing signals, 0.719 volt—i.e. the peak voltage of a sinusoidal signal dissipating 3.45 mW in a 75-ohm resistance.

d) *Shaping of the vestigial sideband*

It has not appeared possible to recommend a single system, and the existing shaping filters, whose characteristics are given in the following Annex, should be used. In these systems, the modulation and demodulation equipments play equal parts in shaping the vestigial-sideband signal.

Interconnection between two different systems should be dealt with by bilateral agreement between the Administrations concerned.

e) *Pilots*

Pilots should be injected at the input to the first line amplifier (after point C in Figure 1/J.72) and should be blocked after the last line amplifier (before point D in Figure 1/J.72).

To facilitate the interconnection of line systems, it is recommended that the following frequencies and levels should be standardized for the pilots in each of the two systems defined in the Annex to this Recommendation.

1st system. — At point B in Figure 1/J.72, the levels of the various pilots should have the following values:

308 kHz: −29.7 dBm
4142 kHz: −22.2 dBm
6142 kHz: −20.3 dBm

2nd system. — At point B in Figure 1/J.72, the level of the pilots shall have the following values.

308 kHz: −39.0 dBm
4029.45 kHz: −39.8 dBm
6200 kHz: −41.7 dBm

Administrations which use different systems should reach bilateral agreement in connection with all the necessary arrangements for interconnecting their line systems at a frontier repeater station.

Whatever system is used, the C.C.I.T.T. recommends that the frequency of the line pilots should have a relative tolerance of 10^{-5}.

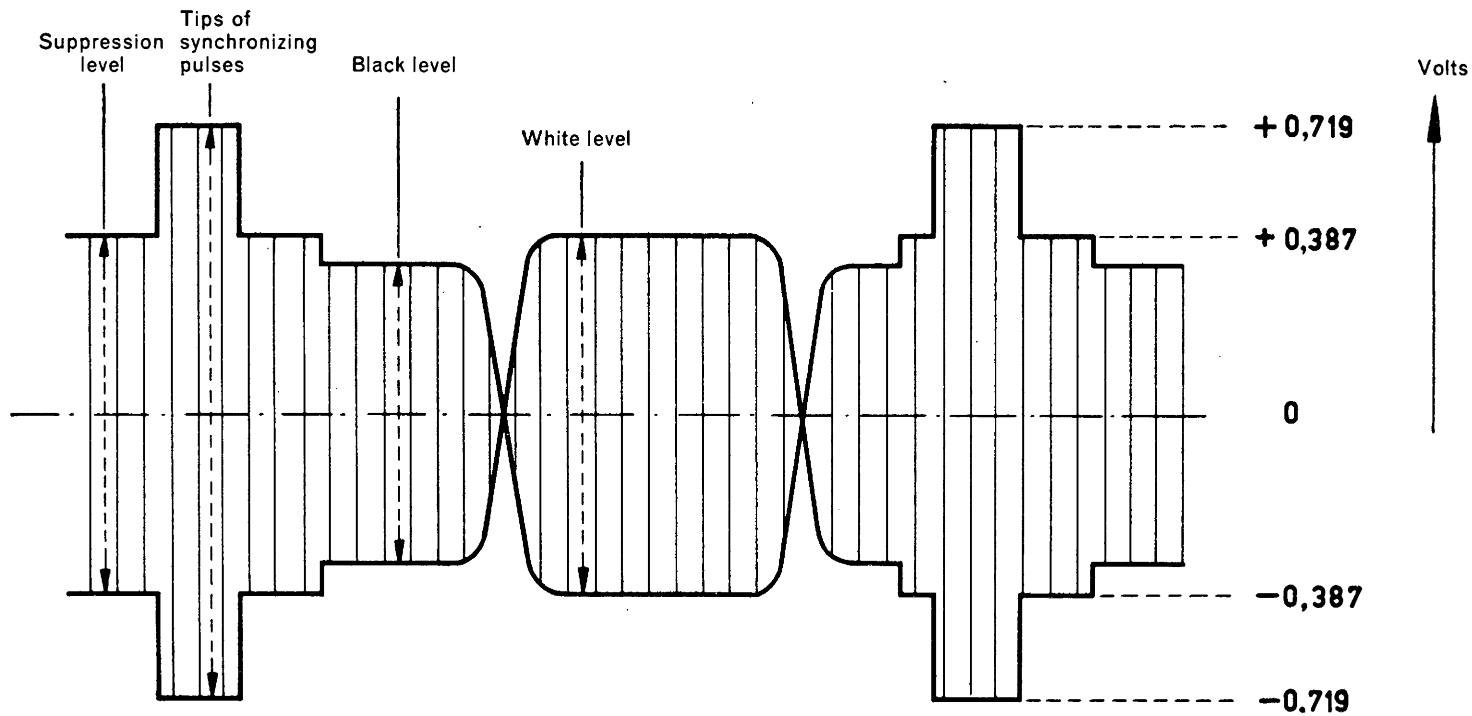
f) *Interference*

Paragraph 3.3 of Recommendation J.61 shows the overall target design value referred to the hypothetical reference circuit for television transmission.

It is provisionally recommended that the overall random noise should be allocated on the basis of 50% to the line and 50% to the three pairs of modulators and demodulators.

g) *Repeater input and output impedance*

The return loss between repeater input and output impedances and a non-reactive resistance of 75 ohms should be at least 20 dB at the carrier frequency used for television.



Note. — The voltages shown are the values measured:

— at the output of the modulation equipment (point B, Figure 1) in 6-MHz systems (Recommendation J.72);

— at a zero relative level point for television transmission in the 12-MHz system (Recommendation J.73).

FIGURE 2/J.73. — **Envelope of carrier modulated by Test Signal No. 2**

The limit permitted for such return loss may decrease progressively to 15 dB at the upper and lower edges of the band of frequencies transmitted for monochrome television.

Note 1. — This being so, at the 1056-kHz carrier frequency and at adjacent frequencies, the overall resultant value of echo in a single repeater section of normal length (sum of the three terms as defined in the Annex to Recommendation J.73) that is obtained is considerably better than the value of 70 dB recommended. The value of 70 dB is, in fact, easily achieved throughout the transmitted band in the case of 6-MHz systems, except at the lower limit of the vestigial sideband, say from 0.5 to 0.7 MHz. A lower figure is in any case acceptable here, as the energy of the signal is small at these frequencies.

Note 2. — The C.C.I.T.T. considered it unnecessary for it to specify other repeater characteristics. For the time being, the arrangements in the case of a cable crossing a frontier should be the subject of bilateral agreement between the countries concerned. (See Recommendation G.352 for the comparable case of telephony on a 2.6/9.5-mm type coaxial cable crossing a frontier.)

ANNEX

(to Recommendation J.72)

Methods used in 6-MHz systems for shaping the television signal transmitted to line

1st system

1. The vestigial-sideband region should cover a band from approximately 500 kHz above the carrier frequency to about 500 kHz below the carrier frequency. This represents a reasonable compromise between the difficulty of designing a narrow-band filter and the difficulty of extending the frequency range of the repeaters in the low-frequency direction.

The same filter is to be used at the transmitting and receiving terminals. The loss of each filter at the carrier frequency should therefore be 3 dB relative to the filter loss at high frequencies where the transmission is single sideband. Thus, after passing through two filters, the sidebands, associated with very low video frequencies will be attenuated by 6 dB, i.e. to one-half of the voltage of the single sideband by which high-frequency information is transmitted. Thus in-phase addition of the two very-low-frequency sidebands produces video information of the same amplitude as the high-frequency information.

With higher video frequencies the vestigial-sideband filters will attenuate the two sidebands unequally. If the filters are phase-equalized the two sidebands will, in the process of demodulation, add in-phase to give the video output.

The requirement, then, to obtain a video output which is independent of frequency is that the sum of the two corresponding sideband amplitudes shall be constant for all video frequencies.

There are many possible filter characteristics which will fulfil this requirement. The mathematically simplest is that producing a linear voltage/frequency characteristic as shown in Figure 3/J.72.

It is, however, not possible to realize this characteristic with practical filters. The difficulty occurs at both extremes of the vestigial-sideband region where the linear characteristic has a discontinuity. Practical filters would round off these regions and it is better to take such limitations into account in specifying the required characteristic.

A characteristic which produces the required sideband amplitudes and takes into account the limitation of practical filters is:

For one send or one receive filter

$$D(f) = 10 \log_{10} ERF(y) \text{ (dB)}$$

where $D(f)$ is the filter loss at frequency f relative to the loss in the single-sideband region;

$$y = \frac{f - f_0}{K}$$

where f_0 is the carrier frequency; K is a constant defining the rate of cut-off of the unwanted sideband.

The function *ERF (y)* is the error function of y defined as:

$$ERF\,(y) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{y} \exp\left(-\frac{y^2}{2}\right) \mathrm{d}y$$

This function will be found tabulated in mathematical tables.

As regards the constant, K, for the definition of the rate of cut-off of the unwanted sideband, a value of $K = 215$ kHz has been proposed by the Cuban Telephone Company.

It is believed that sending and receiving vestigial-sideband terminals using rather different K values may interwork satisfactorily, provided that each terminal equipment is phase-equalized.

2. In specifying the accuracy with which such a characteristic should be met, the limits set should take into account the fact that, for a given error in the video output, a much wider tolerance can be allowed at frequencies at which the filter attenuation is high.

This is satisfied by the following expression:

$$E = \left| 10^{-\frac{D_a}{10}} - 10^{-\frac{D_f}{10}} \right|$$

E is a constant to be specified and which determines tolerances.
D_a is the actual filter discrimination (dB).
D_f is the specified filter discrimination (dB).

2nd system

The lower sideband is attenuated by the combination of transmitting modulator and receiving demodulator, in such a way that between 518 and 1594 kHz the change of amplitude with frequency is linear (see Figure 3/J.72, curve a). At the points where the voltage passes through the values 0 and 100%, there is only negligible rounding of the characteristic. The total filter attenuation required is divided equally between the sending and receiving equipments. Each component filter has an attenuation of 3 dB at the carrier frequency and of 9 dB at 400 kHz below the carrier frequency. Bearing in mind the preceding recommendation, the shape of the amplitude/frequency characteristic of a single filter is therefore that of curve b of Figure 3/J.72. The increase is proportional to the square root of the difference between the frequency considered and 518 kHz, the value being 0 at 518 kHz, 0.707 at 1056 kHz, and 1.0 at 1594 kHz.

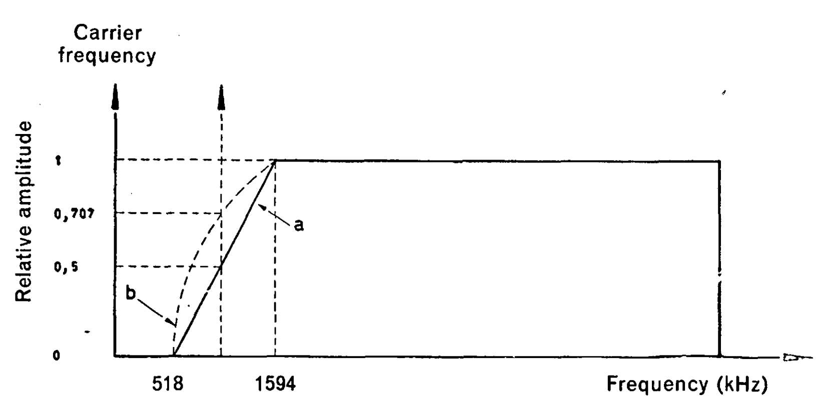


FIGURE 3/J.72. — **Partial suppression of the lower sideband**

No proposal can be made for the allowable deviation from this nominal curve but, for information, it is pointed out that the following characteristic is achieved by the Nyquist filters used by the Federal Republic of Germany. The combined attenuation of the two filters gives a linear voltage/frequency characteristic. When this characteristic passes through 0 and 100% of the voltage, the rounding-off is insignificant. The overall attenuation of the two filters is equally divided between the sending and the receiving equipment. Each partial filter has a 3-dB attenuation at the carrier and a 9-dB attenuation at 400 kHz below the carrier. Thus the slope of the Nyquist filter characteristic is linear between the frequencies.

$$f_1 = 518 \text{ kHz and}$$
$$f_2 = 1594 \text{ kHz.}$$

Recommendation J.73 (modified at Geneva, 1964)

USE OF A 12-MHz SYSTEM FOR THE SIMULTANEOUS TRANSMISSION OF TELEPHONY AND TELEVISION

The 12-MHz coaxial pair system is defined in Recommendation G.337 and its use for telephony transmission in Recommendations G.332 and G.337.

Any 12-MHz system equipped for television transmission should be capable of transmitting the signals used in all those television systems defined by the C.C.I.R. having a video bandwidth not exceeding 5 MHz [if necessary, by means of the switching (in terminal equipments only) of certain components].

This Recommendation has been drafted only for the transmission of monochrome television systems defined by the C.C.I.R. up to 1964.

a) *Carrier frequency*

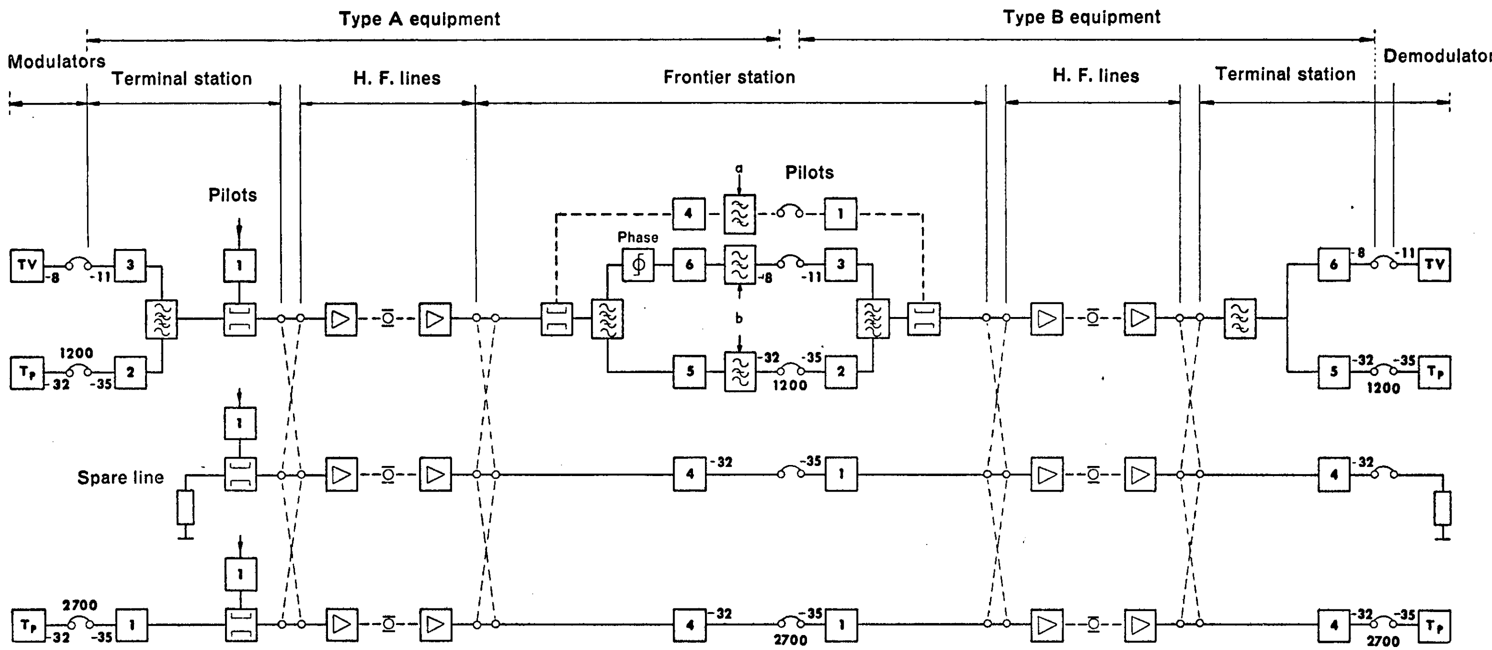
The C.C.I.T.T. recommends the use of a carrier frequency of 6799 kHz with a tolerance of $\pm$ 100 Hz for the transmission of all the television signals indicated above. The video band transmitted over the cable should be 5 MHz wide, whatever television system is to be used. The level provisionally recommended for this carrier has been defined for the interconnection points and is shown in Figures 1/J.73 and 2/J.73 (see Note 3).

b) *Modulation ratio*

Amplitude modulation has to be used. The modulation ratio has to be higher than 100% (as indicated in Figure 2/J.72), so that, when the carrier is modulated by a signal corresponding to blanking level its amplitude is equal to that of the carrier when it is modulated by a signal corresponding to white, assuming that the d.c. component is transmitted.

When test signal No. 2 (see Annex I to Recommendation J.61) is applied at a video junction point, the nominal peak voltage of the modulated carrier, at a point where the relative level for the television transmission is zero, should be as follows:

- for white or blanking level, 0.387 volt (i.e. the peak voltage of a sine wave signal dissipating a power of 1 mW in a resistance of 75 ohms);
- for the synchronizing signals, 0.719 volt (i.e. the peak voltage of a sine wave signal dissipating a power of 3.45 mW in a 75-ohm resistance).



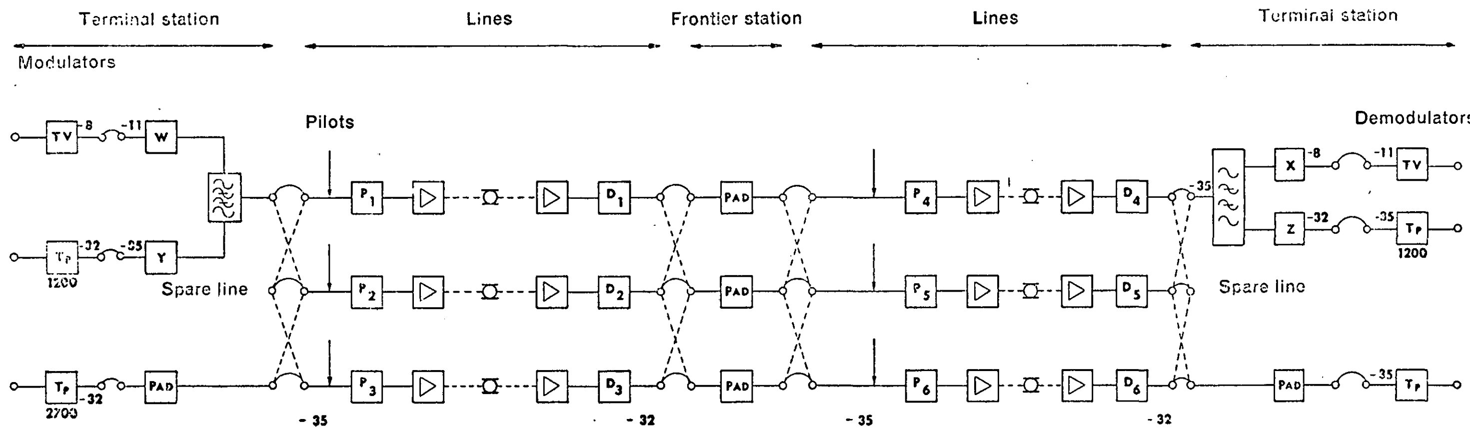
1 4 Pre-emphasis (respectively de-emphasis) for telephony 2700 channels

2 5 Pre-emphasis (respectively de-emphasis) for telephony 1200 channels } Simultaneous transmission

3 6 Pre-emphasis (respectively de-emphasis) for television

a) Pilot pass-filter
b) Pilot stop-filter

FIGURE 1/J.73. — **General case of interconnection of 12-MHz lines**



Nominal relative levels on the line for each telephone channel in the "all-telephony" case

W X Differential pre-emphasis and de-emphasis for television
Y Z Differential pre-emphasis and de-emphasis for telephony 1200 channels
} common for all types of 12-MHz line

P_1 D_1 Pre-emphasis and de-emphasis for telephony, 2700 channels, particular to each design of 12-MHz line

FIGURE 2/J.73. — **Showing use of differential emphasis networks to simplify interconnection of 12-MHz lines of different designs**

Notes on Figures 1/J.73 and 2/J.73

1. Interconnection of pilots, e.g. blocking and re-injecting or by-passing, should be agreed between Administrations.

2. The level of the line pilots is fixed at −10 dBm0 for the all-telephony case. When the line is used to transmit telephony and television simultaneously, different values of pre-emphasis may be required; although the absolute levels of the pilots will remain the same, they may no longer be at −10 dBm0.

3. The television levels shown are those of the modulated carrier, relative to that of the idealized reference signal described in paragraph b of this Recommendation. (See also Figure 2/J.72.)

4. The characteristics of the filters in Figure 1/J.73 (used for separating and combining the telephony and television bands so that the necessary arrangements for pre-emphasis and de-emphasis can be made) must be agreed between Administrations.

c) *Vestigial-sideband shaping*

The shaping of the vestigial-sideband signal has to be carried out entirely at the transmit point. Provisionally, the vestigial sideband should not exceed a width of 500 kHz. Figure 3/J.73 shows the frequency arrangement recommended for television transmission over the 12-MHz system.

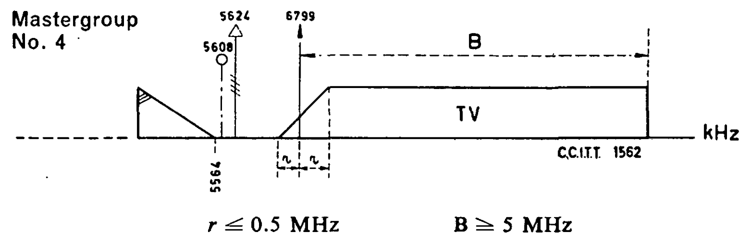


FIGURE 3/J.73. — **Frequency allocation for television transmission on a 12-MHz system**

d) *Relative power levels and interconnection at a frontier section*

It is not possible to recommend relative power levels at the output of intermediate repeaters since they are very closely linked to the inherent design of each Administration's system.

When interconnection between two telephone systems is effected via a cable section that crosses a frontier, in accordance with Recommendation G.352, each Administration should accept, on the receiving side, the level conditions which normally apply to the incoming system used in the other country. It may be possible to comply with this condition simply by insertion of a correcting network at the receiving end. The repeater section crossing the frontier should then be less than 4.5 km long. The details being agreed directly between the Administrations concerned before the repeater stations are sited.

Where a line is to be used alternatively for "all-telephony" or for "telephony-plus-television", such a solution is not generally applicable. In this case, one of the frontier stations may act as a main station having the necessary types of pre-emphasis and de-emphasis networks to permit interconnection at flat points at the recommended levels. Figure 1/J.73 shows how this may be done in the general case and also shows how, at terminal stations, the same interconnections levels are used when connecting the line to telephony and television translating equipment.

However, if a common differential characteristic can be agreed for all types of 12-MHz line, then free interconnection of the full line-bandwidth becomes possible, both nationally (e.g. between working and spare lines) and internationally (between national systems of different designs). This method leads to the simpler interconnection arrangement of Figure 2/J.73.

In this arrangement, the circuit is always lined up for "all telephony". For telephony-plus-television, the emphasis characteristic used for the "all-telephony" case is modified by the insertion, at the terminal equipment stations only, of differential pre-emphasis and de-emphasis networks additional to those used for "all-telephony" transmission.

e) *Repeater input and output impedance*

The return loss between repeater input and output impedances and a non-reactive resistance of 75 ohms should be at least 20 dB at the carrier frequency used for television.

The limit permitted for such return loss may decrease progressively to 15 dB at the upper and lower edges of the band of frequencies transmitted for monochrome television.

Note. — This being so, at the 6799-kHz carrier frequency and at adjacent frequencies, the overall resultant value of echo in a single repeater section of normal length (sum of the three terms as defined in the Annex to this Recommendation) that is obtained is considerably better than the value of 70 dB recommended. The value of 70 dB is, in fact, easily achieved throughout the transmitted band.

f) *Interference*

Paragraph 3.3 of Recommendation J.61 indicates the overall values relative to the hypothetical reference circuit for television transmissions which are taken as objectives for design projects.

In the experience of certain Administrations, the weighted psophometric power can be distributed between the terminal equipment and the line in the ratio of 1 to 4.

In particular, the Administration of the Federal Republic of Germany uses, for the 12-MHz system, the following signal/weighted noise ratio:

a) for terminal modulation equipment	70 dB
b) for terminal demodulation equipment	64 dB
c) for a line 840 km in length	58 dB

These values result in a signal-to-noise ratio of 52 dB at the end of the reference circuit.

ANNEX
(to Recommendation J.73)

Impedance matching between repeaters and coaxial pair in television transmission

Such impedance matching, for television transmission systems having repeater sections of about 9 km, was formerly specified by stating an overall limit, as follows (taken from pages 269 and 270 of Volume III *bis* of the C.C.I.F. *Green Book*, Geneva, 1956).

"Let:

Z_L be the measured line impedance at frequency f seen from a repeater station (see Figure 4/J.73);

Z_E be the measured output impedance at frequency f of the repeater station equipment seen from the line;

Z_R be the measured input impedance at frequency f of the repeater station equipment seen from the line;

A be the total line attenuation al, at frequency f, between two adjacent repeater stations, a being the measured attenuation coefficient of the coaxial pair and l the distance between the two adjacent repeater stations concerned.

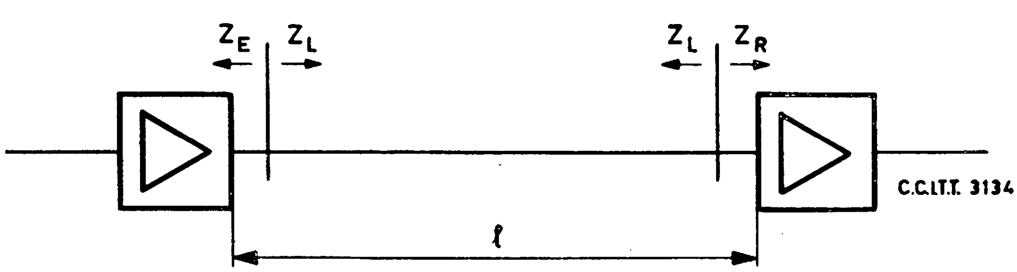


FIGURE 4/J.73. — **Repeater section of a coaxial pair**

Then the value N is defined by the formula

$$N = 2A + 20 \log_{10} \left| \frac{Z_E + Z_L}{Z_E - Z_L} \right| + 20 \log_{10} \left| \frac{Z_L + Z_R}{Z_L - Z_R} \right| \text{ (dB)}$$

Provisionally the condition indicated below should be met.

In the case of a television transmission system, N should be of the order of 70 dB at frequencies adjacent to the virtual carrier frequency used for the line transmission. At frequencies remote from the carrier frequency, lower values of N might be acceptable."

Since then, the C.C.I.T.T. has recommended limits for return loss at the input and output of repeaters, as given in the following Recommendations:

— Recommendation J.71, g, for 4-MHz systems and Recommendation J.72, g, for 6-MHz systems, both of which systems have approximately 9-km repeater sections and a carrier frequency of 1056 kHz;

— Recommendation J.73, e, for the 12-MHz system, with approximately 4.5-km repeater sections and a carrier frequency of 6799 kHz.

These give more stringent limits than the overall limit shown above, which becomes redundant for these systems. However, if in the future the C.C.I.T.T. should define other television transmission systems having a large number of closely spaced repeaters, this overall limit may again become important; in that case it will be necessary to revise and correct this old recommendation quoted above, using more precise terms to specify the impedances concerned.

Recommendation J.74

METHODS FOR MEASURING THE TRANSMISSION CHARACTERISTICS OF TRANSLATING EQUIPMENTS

a) No special measuring method is necessary for the carrier.

b) An oscilloscope can be used, for example, to measure the modulation coefficient.

c) No special method is recommended for measuring pre-emphasis.

d) An oscilloscope can be used, for example, to measure the voltages at the input to the modulating equipment and the output from the demodulating equipment.

e) The following is an example of a method which can be used to measure the random noise at the modulator output:

The input and output video terminals of the modulator are closed with 75-ohm resistances and the modulator is set to give an output carrier power of 1 milliwatt. The random noise power can then be measured with a selective measuring instrument, and the result is given relative to the video-frequency bandwidth for the television system concerned.

To measure noise produced by the demodulator, 1 milliwatt of carrier power is sent to its input, and the random noise at the output is measured at the ouput terminals with a selective measuring instrument.

This method can also be used to measure parasitic noise having a recurrent waveform.

Note. — Methods for measuring parasitic noise in television are being studied.

Recommendation J.75

INTERCONNECTION OF SYSTEMS FOR TELEVISION TRANSMISSION ON COAXIAL PAIRS AND ON RADIO-RELAY LINKS

A. Television transmission only

Direct video transmission over long, e.g. more than about 15 km, coaxial cables is unsatisfactory, because of the likelihood of picking up interference and the difficulties of low-frequency equalization; it is therefore necessary to transmit the television signal as a modulated carrier transmission, usually with a vestigial sideband.

On the other hand, the television signal can be transmitted directly in the baseband of a radio-relay system as a video signal; in general it is advantageous to do so, since this minimizes distortion and enables a better signal-to-noise ratio to be obtained as compared with a modulated signal with vestigial sideband, transmitted in the baseband. This procedure is recommended by the C.C.I.R.

Interconnection between television channels on radio-relay and cable systems will therefore normally take place at video frequencies.

Levels and impedances at interconnection points should then conform to Recommendation J.61.

Exceptionally, in special cases, the video signal can be transmitted over short cables or a vestigial-sideband television signal can be transmitted on short radio-relay links, to allow direct interconnection at line frequencies (radio-relay link baseband). Special arrangements may be necessary in such cases in respect of signal level, pre-emphasis and pilots, to maintain the recommended standard of transmission performance.

B. Telephony and television transmission, alternatively or simultaneously, on coaxial pairs or radio-relay links

a) *Interconnection between a coaxial cable system having alternative transmission of telephony and television and a radio-relay link with the same alternative transmission*

It is recommended that the following conditions should be met at the interconnection point:

1) For telephony transmission, the frequency arrangements, the relative power levels of the telephone channels and the frequency of the pilots should be as indicated in Recommendation G.423.

2) For television transmission, interconnection should generally be made at video frequencies. Levels and impedances at interconnection points should then conform to Recommendation J.61.

b) *Interconnection between a coaxial system having simultaneous telephony and television transmission and a radio-relay link with the same simultaneous transmission*

On all radio-relay links designed for such simultaneous transmission it is intended to transmit video-frequency television signals in the lower part of the baseband and telephony signals in the upper part.

Since these arrangements are incompatible with those which are recommended by the C.C.I.T.T. for simultaneous telephony and television transmission on coaxial cables (Recommendation J.73), it will normally be possible to consider interconnection at video frequencies, only for the television channel and interconnection at group, supergroup or supermastergroup points for telephony.

However, by agreement between the Administrations concerned, direct interconnection may be achieved in special cases on a short system (on cable or radio) by using a frequency allocation recommended for the other type of system.

Recommendation J.76 (Geneva, 1964)

LOCAL LINES FOR TELEVISION TRANSMISSIONS

The C.C.I.T.T. has not issued any recommendations concerning the characteristics of "local lines" for television transmissions as defined in paragraph 1.1.3 of Recommendation J.61.

By way of information Annexes 57 to 60 (Part IV of Volume III, *Blue Book*) describe the arrangements made in various countries:

a) to connect the sending end of an international television connection to the sending terminal station of a long-distance international television circuit, and from the receiving terminal of such a circuit to the receiving end of international television connection;

b) to ensure satisfactory transmission over those local circuits and equipments which are the responsibility of the telecommunications authority.

Similar information may be found in the following articles:

A. MYHRMAN: Video amplifying equipment for television program transmission, *Ericsson Review*, No. 2, 1963.

K. MAEDA: Coaxial cable video transmission system, *Japan Telecommunication Review*, Volume 1, No. 2.

T. HORIGUCHI: Transistorized coaxial cable video transmission system, *Japan Telecommunication Review*, Volume 9, No. 1.