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MAINTENANCE OF INTERNATIONAL SOUND - PROGRAMME AND TELEVISION TRANSMISSION CIRCUITS

LIMITS AND PROCEDURES FOR THE LINING-UP OF A SOUND-PROGRAMME CIRCUIT

ITU-T Recommendation N.21

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation N.21 was published in Fascicle IV.3 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation N.21

LIMITS AND PROCEDURES FOR THE LINING-UP OF A SOUND-PROGRAMME CIRCUIT

1 General

This Recommendation gives limits in Tables 1/N.21 to 5/N.21 for the lining-up of an international sound-programme circuit as defined in Recommendation N.1. These limits correspond to those for one audio section of the hypothetical reference circuit as defined in CCIR Recommendation 502 [1] for 5 kHz, 6.4 kHz, 7 kHz and 10 kHz sound-programme circuits, but correspond to two audio sections[1)] for 15 kHz type sound-programme circuits except for noise limits which correspond to one audio section.

It is recommended to use an automatic measuring equipment (see Recommendations O.31 [3], O.32 [4] and O.33 [5]). If no such equipment is available, measurements shall normally be restricted to loss/frequency distortion and weighted noise. For stereophonic pairs, the parameters Nos. 12, 13, 14 and 15 of Table 1/N.21 shall also be measured.

The limits for 15 kHz and 7 kHz circuits are applicable both for analogue and digital transmissions.

2 Limits for the loss/frequency distortion of the component parts of an international sound-programme circuit

The limits are expressed in terms of the received level relative to the value of the received level at 1020 Hz.[2)] [6]. Some remarks with regard to the impedance at the points of interconnection are given in the introduction to Recommendation N.10.

International sound-programme circuits set up between ISPCs in any particular continent should usually be routed on a single group link (which includes only 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 ISPCs in different continents should not comprise more than three circuit sections.

Sound-programme circuits such as those associated with television transmissions using communication satellite systems are normally provided on a temporary basis. The international sound-programme circuit section is established via the satellite link(s) each time it is required for service. It should be noted that the group carrying the sound-programme circuit may terminate either at the earth station or at an international terminal repeater station.

The possible combination of group-terminals and the number of group-sections required for sound-programme circuits established by satellite link(s) 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.

3 Lining-up procedures

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 CCITT Recommendations, these various sections are interconnected to form the complete international sound-programme circuit.

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1) The limits derived for one audio to audio section for sound-programme circuits of 15 kHz nominal bandwidth calculated in accordance with CCIR Recommendation 605 [2] are not met by the technical specification of available equipment in use on the international network.

2) For further information about the choice of test signal frequency, refer to Recommendation O.6 [7].

When agreement has been reached between two countries, operating via a communication satellite, to provide sound-programme circuits on a temporary 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.

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

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 multiple destination group will coordinate this work in accordance with Recommendation M.460 [8].

3.1 *Measurement of received level* [6]

A test signal of 1020 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 ISPC (for example, – 6 dBm).

An automatic measuring equipment [3], [4], [5], 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 ISPC and at the frontier section 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: 50, 80, 100, 200, 500, 800, 1000, 2000, 3200, 5000 and 6400 Hz [3)]

The equalizers are adjusted to bring the curve within CCITT limits, which are given above.

3.2 *Measurement of group-delay distortion* [6]

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

3.3 *Measurement of circuit noise*

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

These should consist of the weighted noise reading using a meter and network conforming to Recommendation O.41 [10] or CCIR Recommendation 468 [11] or a combination of these.

The noise limits given in the tables of this Recommendation are for circuits of 840 km maximum length. For longer circuits appropriate limits may be calculated from the formula given in CCIR Recommendation 605 [2].

3.4 *Measurement of nonlinearity distortion*

For circuits routed entirely on audio pairs and not equipped with pre-emphasis equipment the nonlinearity 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.

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3) Administrations are invited to propose measuring frequencies for 5 kHz circuits, 7 kHz circuits, and 15 kHz circuits. ISO standard No. 266 [9] should be taken into account.

For a circuit which includes at least one carrier section no measurement of nonlinearity 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 nonlinearity distortion, for example, to locate a fault, the frequency of the sent signal should not exceed 1020 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 [3], [4], [5]).

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[4)] within the transmitted band. For shorter and for less complex circuits, the distortion should be less.

Moreover, since end-to-end measurements of nonlinearity 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.

3.5 *Additional mesurements*

In addition to the measurements specified above, the following parameters may be measured at the discretion of the Administrations concerned. Such measurements may be particularly useful when a faulty condition is suspected.

3.5.1 *Interference caused by power supply sources*

When a sinusoidal test signal is transmitted over a sound-programme circuit at a level of 0 dBmO the level of the strongest unwanted modulation component should not exceed –45 dBmO.

3.5.2 *Frequency error*

The frequency error introduced by a sound programme circuit must not exceed the following limits:

7 kHz, 115 kHz ± 1 Hz

5 kHz, 6.4 kHz, 10 kHz ± 2 Hz

3.6 *Application of a simulated sound-programme test signal*

CCIR Recommendation 571 [12] specifies a simulated sound-programme test equipment which can be used for measuring interference in other channels.

3.7 *Single tone-interference level*

Where this parameter is concerned, the characteristic of the weighting filter according to CCIR Recommendation 468 [11] has to be taken into account by using the correction factor ψ. The latter, which can be determined from Figure 1/N.21 (identical with Figure 1b of CCIR Recommendation 468 [11] is to be subtracted from the numerical values of the tables. To exclude the effect of random noise, selective measurement is needed.

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4) 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 nonlinearity distortion would be:

40 dB at fundamental frequencies above 100 Hz,

34 dB at fundamental frequencies of 100 Hz and below.

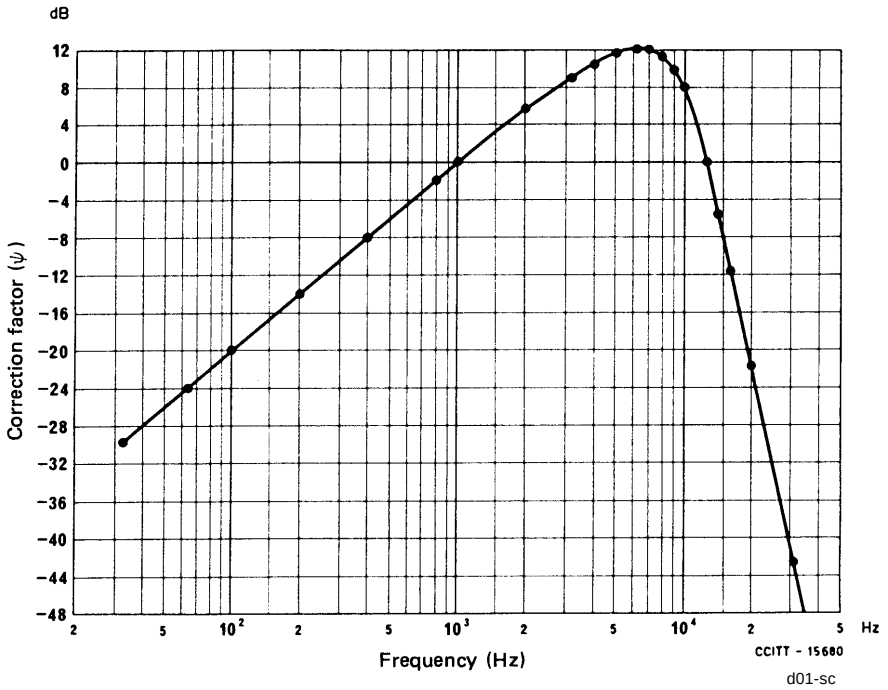

FIGURE 1/N.21

Correction factor ψ, for single-tone interference level

3.8 *Measurement of stereophonic pairs*

The quality criteria given refer to those of Recommendations O.32 [4] and O.33 [5]. The limits can be easily measured with the aid of such equipments. If other measuring means are used, attention is drawn to the fact that the frequencies of 10, 11.92 and 14 kHz should be avoided because of possible stop filters which may be inserted in the transmission equipment concerned for reducing carrier leaks.

3.9 *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.

TABLE 1/N.21

Limits for the lining-up of 15 kHz sound-programme circuits

Item	Parameter		Unit	Limits
1	Insertion gain	Adjustement error	dB	± 0.4
		Variation during 24 h	dB	± 0.4
2	Gain/frequency response referred to 0.8 ou 1 kHz	0.04 to 0.125 kHz	dB	+ 0.4
			dB	−1.5
		0.125 to 10 kHz	dB	± 0.4
		10 to 14 kHz	dB	+ 0.4
			dB	−1.5
		14 to 15 kHz	dB	+ 0.4
			dB	− 2.3
3	Groupe delay/frequency response referred to minimum	0.04 kHz	ms	37
		0.075 kHz	ms	16
		14 kHz	ms	5.4
		15 kHz	ms	8
4	Weighted noise	Idle channel	dBq0ps	− 47
		Programme-modulated	dBq0ps	− 35
5	Single tone interference level + ψ		dBm0s	− 75
6	Disturbing modulation by power supply		dB	− 47
7	Total harmonic distortion	0.04 to 0.125 kHz	%	0.8
		0.125 to 7.5 kHz	%	0.4

TABLE 1/N.21 (*cont.*)

	Item	Parameter		Unit	Limits
	8	3rd order difference tone at 0.18 kHz		%	0.4
	9	Error in reconstituted frequency		Hz	± 0.8
	10	Intelligible crosstalk ratio	0.04 kHz	dB	52
			0.5 to 5 kHz	dB	76
			15 kHz	dB	62
	11	Error in amplitude/amplitude response		dB	± 0.4
Additional parameters for stereo transmission	12	Difference in gain between A and B channels	0.04 to 0.125 kHz	dB	1.1
			0.125 to 10 kHz	dB	0.6
			10 to 14 kHz	dB	1.1
			14 to 15 kHz	dB	2.3
	13	Phase difference between A and B channels	0.04 to 0.2 kHz	degree	23
			0.2 to 4 kHz	degree	11
			14 kHz	degree	23
			14 to 15 kHz	degree	30
	14	Intelligible crosstalk ratio A/B		dB	52
	15	Crosstalk ratio (intermodulation) A/B		dB	62

TABLE 2/N.21

Limits for the lining-up of 10 kHz international sound-programme circuits

Item	Parameter		Unit	Limits
1	Insertion gain	Adjustment error	dB	± 0,3
		Variation with time	dB	± 0,3
2	Gain/frequency response referred to 0.8 or 1 kHz	0,05 to 0,1 kHz	dB	+ 0,8
			dB	– 2,1
		0,1 to 0,2 kHz	dB	+ 0,8
			dB	–1,2
		0.2 to 6 kHz	dB	± 0.8
		6 to 8.5 kHz	dB	+ 0.8
			dB	– 1.2
		8.5 to 10 kHz	dB	+ 0.8
			dB	–2.1
3	Group delay/frequency response referred to minimum	0.05 kHz	ms	26
		0.1 kHz	ms	6.6
		10 kHz	ms	2.4
4	Weighted noise (Idle channel) [a]		dBq0ps	– 44
5	Single tone interference level + ψ [b]		dBm0s	– 75
6	Disturbing modulation by power supply		dB	–51
7	Total harmonic distortion	0.05 to 0.1 kHz	%	1.4
		0.1 to 10 kHz	%	1
8	3rd order difference tone at 0.18 kHz		%	1
9	Error in reconstituted frequency		Hz	± 0.5
10	Intelligible crosstalk ratio [c]		dB	80
11	Error in amplitude/amplitude response		dB	± 0.2

[a] For circuits on carrier systems, it is not always possible, in absence of special precautions, to meet these limits (see Annex II to CCIR Recommendation 504 [13]).

[b] Or 20 dB below measured weighted noise level, whichever is higher.

[c] It is in some cases difficult or impossible to meet these limits (see § 3.8, Note 2, in Annex I to CCIR Recommendation 504 [13]).

TABLE 3/N.21

Limits for the lining-up of 7 kHz international sound-programme circuits

Item	Parameter		Unit	Limits
1	Insertion gain	Adjustment error	dB	± 0.3
		Variation during 24 h	dB	± 0.3
2	Gain/frequency response referred to 0.8 or 1 kHz	0.05 to 0.1 kHz	dB	+ 0.5
			dB	–1.4
		0.1 to 6.4 kHz	dB	± 0.5
		6.4 to kHz	dB	+ 0.5
			dB	–1.4
3	Group delay/frequency response referred to minimum	0.05 kHz	ms	26
		0.1 kHz	ms	6.6
		6.4 kHz	ms	1.7
		7 kHz	ms	3.3
4	Weighted noise	Idle channel	dBq0ps	– 49
		Programme-modulated	dBq0ps	–37
5	Single tone interference level + ψ		dBm0s	–79
6	Disturbing modulation by power supply		dB	–51
7	Total harmonic distortion	< 0.1 kHz	%	1
		0.1 to 3.5 kHz	%	0.7
8	3rd order difference tone at 0.18 kHz		%	0.7
9	Error in reconstituted frequency		Hz	± 0.5
10	Intelligible crosstalk ratio	0.05 kHz	dB	59
		0.05 to 3.2 kHz	dB	80
		7 kHz	dB	73
11	Error in amplitude/amplitude response		dB	± 0.2

TABLE 4/N.21

Limits for the lining-up of 6.4 kHz international sound-programme circuits

Item	Parameter		Unit	Limits
1	Insertion gain	Adjustment error	dB	± 0.3
		Variation during 24 h	dB	± 0.3
2	Gain/frequency response referred to 0.8 or 1 kHz	0.05 to 0.1 kHz	dB	+ 0.5
			dB	–1.4
		0.1 to 5 kHz	dB	± 0.5
		5 to 6.4 kHz	dB	+ 0.5
			dB	–1.4
3	Group delay/frequency response referred to minimum	0.05 kHz	ms	26
		0.1 kHz	ms	6.6
		5 kHz	ms	1.7
		6.4 kHz	ms	3.3
4	Maximum weighted noise level		dBq0ps	– 44
5	Single tone interference level + ψ		dBm0s	–79
6	Disturbing modulation by power supply		dB	–51
7	Total harmonic distortion	< 0.1 kHz	%	1
		> 0.1 kHz	%	0.7
8	3rd order difference tone at 0.18 kHz		%	0.7
9	Error in reconstituted frequency		Hz	± 0.5
10	Intelligible crosstalk ratio	0.05 kHz	dB	59
		0.5 to 3.2 kHz	dB	80
		6.4 kHz	dB	73
11	Error in amplitude/amplitude response		dB	± 0.2

TABLE 5/N.21

Limits for the lining-up of 5 kHz international sound-programme circuits

Item	Parameter		Unit	Limits
1	Insertion gain	Adjustment error	dB	± 0.3
		Variation during 24 h	dB	± 0.3
2	Gain/frequency response referred to 0.8 or 1 kHz	0.07 to 0.2 kHz	dB	+ 0.5
			dB	–1.4
		0.2 to 4 kHz	dB	± 0.5
		4 to 5 kHz	dB	+ 0.5
			dB	–1.4
3	Group delay/frequency response referred to minimum	0.07 kHz	ms	20
		5 kHz	ms	5
4	Maximum weighted noise level		dBq0ps	–37
5	Single tone interference level + ψ		dBm0s	–79
6	Disturbing modulation by power supply		dB	–51
7	Total harmonic distortion	< 0.1 kHz	%	1
		> 0.1 kHz	%	0.7
8	3rd order difference tone at 0.18 kHz		%	0.7
9	Error in reconstituted frequency		Hz	± 0.5
10	Intelligible crosstalk ratio	0.07 kHz	dB	63
		0.5 to 3.2 kHz	dB	80
		5 kHz	dB	76
11	Error in amplitude/amplitude response		dB	± 0.2

References

[1] CCIR Recommendation *Hypothetical reference circuits for sound-programme transmissions*, Vol. XII, Rec. 502, ITU, Geneva, 1986.

[2] CCIR Recommendation *Estimation of transmission performance of sound-programme circuits shorter or longer than the hypothetical reference circuit*, Vol. XII, Rec. 605, ITU, Geneva, 1986.

[3] CCITT Recommendation *Automatic measuring equipment for sound-programme circuits*, Vol. IV, Rec. O.31.

[4] CCITT Recommendation *Automatic measuring equipment for stereophonic pairs of sound-programme circuits*, Vol. IV, Rec. O.32.

[5] CCITT Recommendation *Automatic equipment for rapidly measuring stereophonic pairs and monophonic sound-programme circuits, links and connections,* Vol. IV, Rec. O.33.

[6] CCIR Report *Relative values of sound-programme signal levels established with the VU meter and with a peak-programme meter*, Vol. XII, Rep. 820, Geneva, 1986.

[7] CCITT Recommendation *1020 Hz reference test frequency,* Vol. IV, Rec. O.6.

[8] CCITT Recommendation *Bringing international group, supergroup, etc., links into service*, Vol. IV, Rec. M.460.

[9] ISO Standard No. 266 *Acoustics-preferred frequencies for measurements*.

[10] CCITT Recommendation *Psophometers (apparatuses for the objective measurements of circuit noise)*, Vol. IV, Rec. O.41.

[11] CCIR Recommendation *Measurement of audio-frequency noise voltage level in sound broadcasting,* Vol. X, Rec. 468, ITU, Geneva, 1986.

[12] CCIR Recommendation *A conventional test signal simulating sound-programme signals for measuring interference in other channels*, Vol. XII, Rec. 571, ITU, Geneva, 1986.

[13] CCIR Recommendation *Performance characteristics of 10 kHz type sound-programme circuits*, Vol. XII, Rec. 504, ITU, Geneva, 1982.