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MAINTENANCE: INTERNATIONAL LEASED CIRCUITS

CHARACTERISTICS OF SPECIAL QUALITY INTERNATIONAL LEASED CIRCUITS WITH SPECIAL BANDWIDTH CONDITIONING

ITU-T Recommendation M.1020

(Previously “CCITT Recommendation”)

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation M.1020 was revised by the ITU-T Study Group IV (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

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NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

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

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CONTENTS

			Page
1	Scope		1
2	Characteristics		1
	2.1	Nominal overall loss	1
	2.2	Loss/frequency distortion	1
	2.3	Group-delay distortion	1
	2.4	Variation of overall loss with time	3
	2.5	Random circuit noise	3
	2.6	Impulsive noise	3
	2.7	Phase jitter	3
	2.8	Total distortion (including quantizing distortion)	3
	2.9	Single tone interference	3
	2.10	Frequency error	3
	2.11	Harmonic and intermodulation distortion	4
	2.12	Crosstalk	4
	2.13	Power source interferences	4
Annex A – Noise and distortion			4
	A.1	Random circuit noise	4
	A.2	Total distortion	5
References			5

ABSTRACT

This Recommendation provides the characteristic of a circuit, especially applicable for use by modems without equalizer, for data transmission rates higher than those normally achievable on telephone-type circuits.

KEYWORDS

Characteristics, leased circuits, special bandwidth conditioning.

CHARACTERISTICS OF SPECIAL QUALITY INTERNATIONAL LEASED CIRCUITS WITH SPECIAL BANDWIDTH CONDITIONING[1)]

(Published in 1980; revised in 1984, 1988 and 1993)

1 Scope

This Recommendation deals with leased circuits for uses other than telephony – for example, data transmission.

The requirements of this Recommendation are intended to ensure the provision of a circuit which will meet the requirements of digital transmission rates higher than those possible on a normal telephone-type circuit. In particular, circuits meeting the requirements of this Recommendation are intended for use with modems that do not contain equalizers.

2 Characteristics[2)]

2.1 Nominal overall loss

Because of the differing nominal level at renters' premises due to the various national practices, it is not normally possible to predict the nominal overall loss of the circuit at the reference frequency. Only exceptionally can a predetermined specified nominal overall loss at the reference frequency between renters' installations be offered to renters and then only after prior consultation among the Administrations concerned.

For 4-wire circuits the value of the receiving relative level at the renters' premises should not be lower than –13 dBr.

For circuits intended to be used for data transmission using modems to V-Series Recommendations, higher receiving relative levels may be required in some circumstances. Reference should be made to Supplement No. 2.16, *Blue Book*, Volume IV (Fascicle IV.3).

It should be noted that the overall loss in each direction of transmission may not have the same value.

2.2 Loss/frequency distortion

The limits for the overall loss relative to that at 1020 Hz for the circuit between renters' installations are given in Figure 1.

2.3 Group-delay distortion

The limits that apply to group-delay distortion are given in Figure 2 in which the limiting values over the frequency band are expressed as values relative to the minimum measured group delay.

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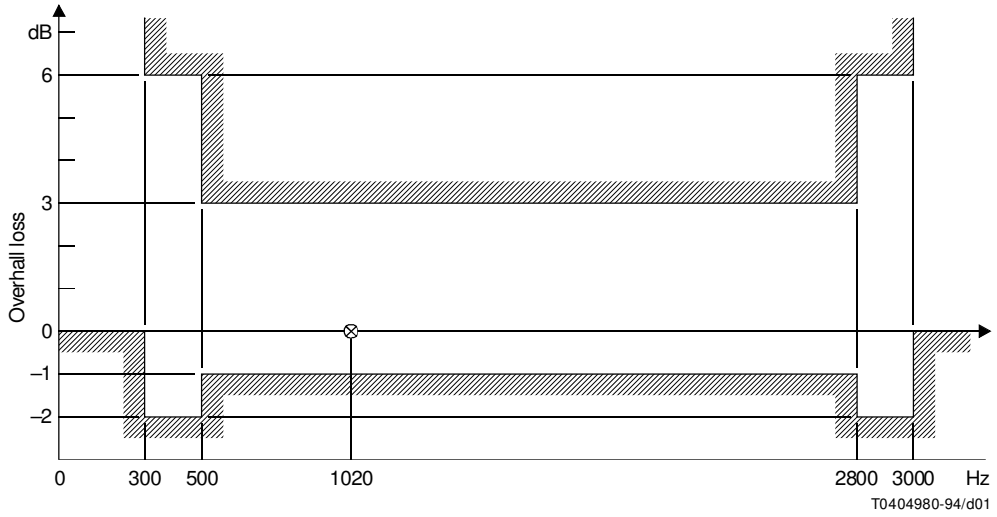
1) The application of this Recommendation to multiterminal leased circuits is intended only for radial networks in which these specifications are to be met between a designated central station and each of the outlying stations. It does not apply to multiterminal conference networks between any two stations.

2) Additionally, the characteristics and limits for short interruptions in transmission and phase hits are under study for inclusion in this Recommendation. It may be noted that clause 6/M.1060 [11] gives provisional limits for short interruptions in transmission and phase hits as guidance for fault finding purposes.



NOTES

1 Below 300 Hz and above 3000 Hz the loss shall not be less than 0.0 dB but is otherwise unspecified.

2 1020 Hz is the reference test frequency as explained in Recommendation O.6 [9].

FIGURE 1/M.1020

Limits for overall loss of the circuit relative to that at 1020 Hz

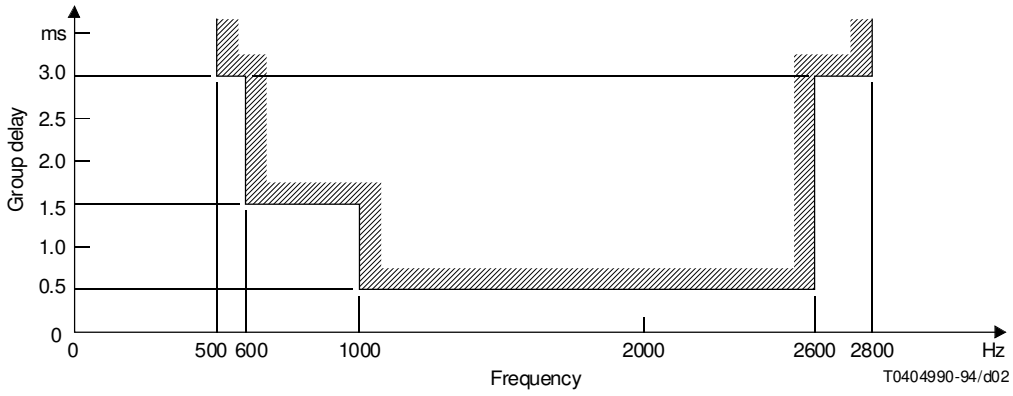


FIGURE 2/M.1020

Limits for group delay relative to the minimum measured group delay in the 500-2800 Hz band

2.4 Variation of overall loss with time

2.4.1 Amplitude hits

Where the circuit is to be used for data transmission using modems employing amplitude modulation techniques, for example, modems to Recommendation V.29 [1], amplitude hits may result in data errors. Using an instrument complying with Recommendation O.95 [2], the number of amplitude hits greater than ± 2 dB should not exceed 10 in any 15 minute measuring period. The value of ± 2 dB and the number of amplitude hits are provisional and subject to further study.

2.4.2 Other variations

For all circuits, variations with time of the overall loss at 1020 Hz (including daily and seasonal variations but excluding amplitude hits) should be as small as possible but should not exceed ± 4 dB.

2.5 Random circuit noise

The level of the psophometric noise power at a renter's premises depends upon the actual constitution of the circuit, in particular upon the length of circuit of frequency division multiplex carrier systems in the circuit. The provisional limit for leased circuits of distances greater than 10 000 kilometres is –38 dBm0p. However, circuits of shorter length will have substantially less random noise (see also Annex A and 3.5/M.1050 [10]).

2.6 Impulsive noise

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [3]. As a provisional limit, the number of impulsive noise peaks exceeding –21 dBm0 should not be more than 18 in 15 minutes.

2.7 Phase jitter

The value of phase jitter measured at a renter's premises depends upon the actual constitution of the circuit (for example, upon the number of modulation equipments involved). It is expected that any measurement of phase jitter using an instrument complying with Recommendation O.91 [4] will not normally exceed 10° peak-to-peak. However, for circuits of necessarily complex constitution and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. The limits for low frequency phase jitter are under study.

2.8 Total distortion (including quantizing distortion)

On a mixed analogue/digital circuit, the signal will be accompanied by quantizing distortion. An end-to-end distortion measurement made using an instrument conforming to Recommendation O.132 [5] will include contributions from random circuit noise, single tone interference and harmonic distortion. The level of random noise power at the renter's premises depends upon the length of circuit of frequency division multiplex carrier systems. The level of quantizing distortion power depends on the number of unintegrated digital processes in the circuit.

The signal-to-total-distortion ratio should be better than 28 dB using a sine wave signal at –10 dBm0 (see also Annex A).

2.9 Single tone interference

The level of single tone interference in the band 300-3400 Hz shall not exceed a value which is 3 dB below the circuit noise objective indicated in Figure A.1.

2.10 Frequency error

The frequency error introduced by the circuit must not exceed ± 5 Hz. It is expected that in practice the error will be within closer limits than these.

2.11 Harmonic and intermodulation distortion

When a 700 Hz test frequency of –13 dBm0 is injected at the transmit end of a point-to-point circuit, the level of any individual harmonic frequency at the receiving end shall provisionally be at least 25 dB below the received level of the fundamental frequency.

When intermodulation products are measured using an instrument complying with Recommendation O.42 at a four-frequency signal of the total level –13 dBm0 the second and third order products at the receiving end shall be at least 25 and 26 dB below the received four-frequency signal respectively [8]. These values are provisional and are for further study.

2.12 Crosstalk

Crosstalk attenuation at the near end (between forward and reverse transmission direction of a leased circuit) should not be less than 43 dB. Crosstalk attentuation between different circuits (between leased circuits and between a leased and any other telephone-type circuit) should not be less than 58 dB.

2.13 Power source interferences

When a sine wave signal is transmitted over the circuit at a 0 dBm0, each side component level should not exceed –45 dBm0.

Annex A

Noise and distortion

(This annex forms an integral part of this Recommendation)

A.1 Random circuit noise

Figure A.1 displays random noise versus length of circuit of FDM carrier systems and is presented as a guide to the random noise performance which may be found on an international leased circuit.

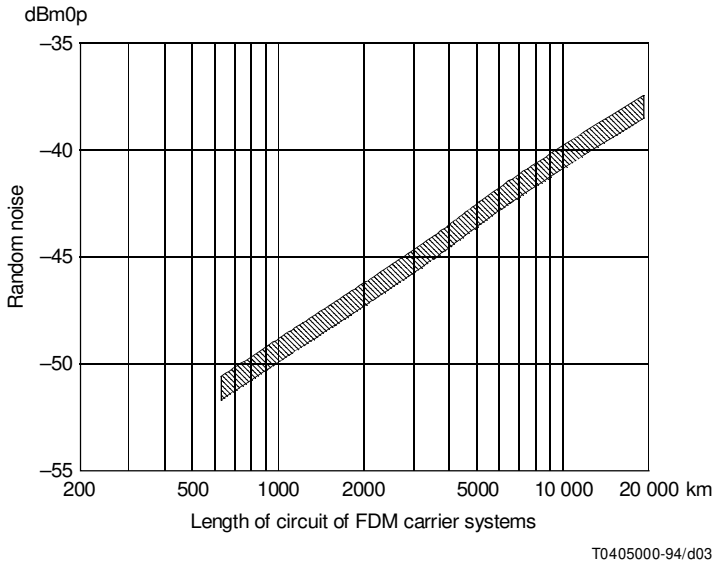


FIGURE A.1/M.1020

Random circuit-noise performance

NOTE – At the present time the section of the circuit provided by a satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pW0p (–50 dBm0p) of noise. Therefore, for the purpose of determining maintenance limits for noise measurement on leased circuits, the length of this section may be considered to be equivalent to 1000 km in Figure A.1.

The contribution to noise of a circuit section provided by a satellite employing TDM technique remains as a subject for further study.

A.2 Total distortion

Table A.1 is a guide to the signal-to-total distortion ratio which may be found on circuits with different analogue section lengths and numbers of quantizing distortion units (QDU). When interpreting this table, particularly for circuits with long analogue sections, it should be noted that it may be possible to increase the number of QDUs in a circuit provided the analogue sections contribute less noise than might be expected from Figure A.1.

TABLE A.1/M.1020

Signal-to-total distortion ratio using a sinusoidal signal at –10 dBm0

Type of circuit	Number of QDUs (Note)	Unit	Distance in analogue transmission (km)						
			< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 000	10 001 to 20 000
Analogue	0	dB	43	41	38	36	33	30	28
Composite circuit	1	dB	34	34	33	32	31	29	28
	2	dB	32	31	31	31	29	28	28
	3	dB	30	30	30	29	28	28	28
	4	dB	29	29	28	28	28	28	28
	5	dB	28	28	28	28	28	28	28
NOTE – The number of QDUs contributed by various digital processes are given in Table 1/G.113 [7].									

References

[1] CCITT Recommendation *9600 bit/s modem standardized for use on point-to-point 4-wire leased telephone-type circuits*, Rec. V.29.

[2] CCITT Recommendation *Phase and amplitude hit counters for telephone-type circuits*, Rec. O.95.

[3] CCITT Recommendation *Impulsive noise measuring equipment for telephone-type circuits*, Rec. O.71.

[4] CCITT Recommendation *Phase jitter measuring equipment for telephone circuits*, Rec. O.91.

[5] CCITT Recommendation *Quantizing distortion measuring equipment using a sinusoidal test signal*, Rec. O.132.

[6] CCITT Recommendation *Equipment to measure non-linear distortion using the 4-tone intermodulation method*, Rec. O.42.

[7] CCITT Recommendation *Transmission impairments*, Rec. G.113.

[8] *Transmission Systems for communications (revised third edition) by members of the technical staff, Bell Telephone Laboratories* – Chapter 8: Modulation distortion in AM systems; Formulae: (8-18) and (8-20).

[9] CCITT Recommendation *1020 Hz reference test frequency*, Rec. O.6.

[10] CCITT Recommendation *Lining up an international point-to-point leased circuit*, M.1050.

[11] CCITT Recommendation *Maintenance of international leased circuits*, M.1060.