



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

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TELECOMMUNICATION
STANDARDIZATION SECTOR
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INTERNATIONAL ANALOGUE CARRIER SYSTEMS

GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS

ASSUMPTIONS FOR THE CALCULATION OF NOISE ON HYPOTHETICAL REFERENCE CIRCUITS FOR TELEPHONY

ITU-T Recommendation G.223

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.223 was published in Fascicle III.2 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.

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Recommendation G.223

ASSUMPTIONS FOR THE CALCULATION OF NOISE ON HYPOTHETICAL REFERENCE CIRCUITS FOR TELEPHONY

(Remark of Recommendation G.222, Volume III of the Red Book, amended at Geneva, 1964; further amended)

1 Nominal mean power during the busy hour

To simplify calculations when designing carrier systems on cables or radio links, the CCITT has adopted a *conventional* value to represent the *mean absolute power level* (at a zero relative level point) of the speech plus signalling currents, etc., transmitted over a telephone channel in one direction of transmission during the busy hour.

The value adopted for this mean absolute power level corrected to a zero relative level point is -15 dBm0 (mean power = 31.6 microwatts); this is the mean with time and the mean for a large batch of circuits.

Note 1 - This conventional value was adopted by the CCIF in 1956 after a series of measurements and calculations had been carried out by various Administrations between 1953 and 1955. The documentation assembled at the time is indicated, in [1]. The adopted value of about 32 microwatts was based on the following assumptions:

- i) mean power of 10 microwatts for all signalling and tones (Recommendation Q.15 [2], gives information concerning the apportionment on an energy basis of signals and tones);
- ii) mean power of 22 microwatts for other currents, namely:
 - speech currents, including echoes, assuming a mean activity factor of 0.25 for one telephone channel in one direction of transmission;
 - carrier leaks (see Recommendations G.232, § 5; G.233, § 11; G.235, § 5); and the Recommendations cited in [3] and [4];
 - telegraph signals, assuming that few telephone channels are used for VF telegraphy systems (output signal power 135 microwatts (the Recommendation cited in [5])) or phototelegraphy (amplitude modulated signal with a maximum signal power of about 1 milliwatt (the Recommendation cited in [6])).

On the other hand, the power of pilots in the load of modern carrier systems has been treated as negligible.

The reference to "the busy hour" in § 1 is to indicate that the limit (of -15 dBm0) applies when transmission systems and telephone exchanges are at their busiest so that the various factors concerning occupancy and activity of the various services and signals are to be those appropriate to such busy conditions.

It is not intended to suggest that an integrating period of one hour may be used in the specification of the signals emitted by individual devices connected to transmission systems. This could lead to insupportably high short-term power levels being permitted which give rise to interference for durations of significance to telephony and other services.

Note 2 - The question of reconsidering the assumptions leading to this conventional value arose in 1968 for the following reasons:

- changes in the r.m.s. power of speech signals, due to the use of more modern telephone sets, to a different transmission plan, and perhaps also to some change in subscriber habits;
- change in the mean activity factor of a telephone channel due, *inter alia*, to different operating methods;
- increase in the number of VF telegraphy bearer circuits and sound-programme circuits;
- introduction of circuits used for data transmission, and rapid increase in their number.

During several Study Periods these points have been under study and various Administrations carried out measurements of speech signal power and loading of carrier systems. The results are shown in Supplement No. 5. These results indicate that there is no sufficiently firm information to justify an alteration to the conventional mean value of -15 dBm0 (32 μ W0) for the long-term mean power level per channel.

Indeed, the steps envisaged by Administrations to control and reduce the levels of non-speech signals indicate a tendency to limit the effect of the increase in the non-speech services.

As regards the subdivision of the 32 μ W into 10 μ W signalling and tones and 22 μ W speech and echo, carrier leaks, and telegraphy, again there is no evidence which would justify proposals to alter this subdivision.

As a general principle, it should always be the objective of Administrations to ensure that the *actual* load carried by transmission systems does not significantly differ from the *conventional* value assumed in the design of such systems.

Note 3 - The CCITT has agreed to the following rules concerning the maximum permissible number of VF telegraph bearer circuits:

- 1) For a *12-channel system*, both the load capacity and the intermodulation requirements are determined by the statistics of speech; hence there is no reason to limit the number of channels in a 12-channel system which may be used as VF telegraphy bearer channels.
- 2) For a *60-channel system*, the load capacity is determined by the statistics of speech but the intermodulation requirements for a mixed VF telegraph and speech loading become controlling when the VF telegraph bearers exceed about 30% of the total. Hence it is possible, without change of specifications, to allow up to 20 channels in this system to be used for VF telegraphy.
- 3) For a *120-channel system*, about 12% of the total could be allowed for VF telegraph bearers. The number of reserve circuits for VF telegraphy is excluded from these limits for both 60- and 120-channel systems. The number of channels for these systems should be distributed more or less uniformly throughout the line-frequency band.
- 4) For *systems with 300 or more channels*, the CCITT is not yet able to define any specific limit, owing to the many complicated factors such as mean power, peak power, overload capacity, intermodulation, noise-performance and pre-emphasis, which have to be taken into consideration.
- 5) For *groups and supergroups* no conclusion could be obtained. From information available, it would be unwise, without special consideration, to exceed two VF telegraph systems per supergroup in a wideband system.
- 6) For *transmission systems not exceeding 1000 km* the permissible number of telegraph systems may be increased if the power per telegraph channel is reduced according to Table 1/G.223.

A similar table in respect of transmission systems longer than 1000 km cannot be drawn up at this time. There is evidence to suggest that for systems considerably longer than 1000 km a reduction in telegraph signal power gives rise to unacceptable levels of telegraph distortion and character error rates.

TABLE 1/G.223

Total number of circuits provided by the transmission system (N)	Approximate number of circuits that may be used for 24-channel FM voice frequency telegraph systems with the indicated power level/TG channel (dBm0)			
	-22.5	-22.5	-27.0	-28.5
12	12	12	12	12
60	20	60	60	60
120	14	42	84	120
300 or more	N/30	N/10	N/5	N