INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.212

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INTERNATIONAL ANALOGUE CARRIER SYSTEMS

GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS

HYPOTHETICAL REFERENCE CIRCUITS FOR ANALOGUE SYSTEMS

ITU-T Recommendation G.212

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.212 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.212

HYPOTHETICAL REFERENCE CIRCUITS FOR ANALOGUE SYSTEMS

GENERAL DEFINITIONS

1 hypothetical reference circuit

F: circuit fictif de référence

S: circuito ficticio de referencia

This is a hypothetical circuit of defined length and with a specified number of terminal and intermediate equipments, this number being sufficient but not excessive. It forms a basis for the study of certain characteristics of long-distance circuits (noise, for example).

2 hypothetical reference circuit for telephony

F: circuit fictif de référence pour la téléphonie

S: circuito ficticio de referencia para la telefonía

This is a complete telephone circuit (between audio-frequency terminals) established on a hypothetical international telephone carrier system and having a specified length and a specified number of modulations and demodulations of channels, groups, supergroups, these numbers being reasonably great but not having their maximum possible values. The hypothetical reference circuit has to reflect what is generally expected to be the practical application of the system.

Various hypothetical reference circuits for telephony have been defined to allow the coordination of the different specifications concerning the constituent parts of the multichannel carrier telephone systems, so that the complete telephone circuits set up on these systems can meet CCITT standards.

In order to take account of the variety of operating conditions and in particular the differences there may be in the size of the countries to be served, the CCITT has defined two categories of hypothetical reference circuits for telephony:

- a set of hypothetical reference circuits with a length of 2500 km,
- a hypothetical reference circuit with a length of 5000 km (see Recommendation G.215).

The former includes the following hypothetical reference circuits for telephony:

- on open-wire lines (see Recommendation G.311),
- on symmetric pair cable (see Recommendation G.322),
- on coaxial pair cable (see Recommendations G.332 to G.346 of sections 3.3 and 3.4).

The 5000 km hypothetical reference circuit is used in various types of carrier systems on coaxial cable and on radio relay systems.

The CCIR also has defined the following hypothetical-reference circuits for telephony:

1) In line-of-sight radio-relay systems using frequency-division multiplex, with a capacity of 12 to 60 telephone channels or of more than 60 telephone channels (see Recommendation G.431 or CCIR Recommendations 391 [2] and 392 [3]);
2) On tropospheric-scatter radio-relay systems (see CCIR Recommendation 396 [4]);
3) For satellite systems (see CCIR Recommendation 352 [5]).

Each of these various hypothetical reference circuits has the same total length[1] and they are all used in the same way. They are only a guide for planning carrier systems.

These hypothetical reference circuits allow designers to study through connection between different carrier systems at basic groups, supergroups, etc., as discussed in Recommendation G.211. Moreover, when they contain more than one pair of channel modulators and demodulators, they also allow the designers to study an international switched connection having the same total length.

3 homogeneous section

F: section homogène

S: sección homogénea

A section without diversion or modulation of any channel groups, supergroups, etc., established on the system which is being considered except for those modulations or demodulations defined at the ends of the section.

All the hypothetical reference circuits defined above consist of homogeneous sections of equal length [6, 9 or 12 sections[2] as the case may be].

It is assumed that at the end of each homogeneous section, the channels, groups, supergroups, etc., are connected through at random.

4 psophometric power

F: puissance psophométrique

S: potencia sofométrica

Where square law addition (power addition) of noise can be assumed, it has been found convenient for calculations and design of international circuits to use the idea of psophometric power as defined below:

$$\text{psophometric power} = \frac{(\text{psophometric voltage})^2}{600}$$

or

$$\text{psophometric power} = \frac{(\text{psophometric e.m.f.})^2}{4 \times 600}$$

A convenient unit is the micro-microwatt or picowatt (pW), and this equation can then be given as follows:

$$\text{psophometric power} = \frac{(\text{psophometric e.m.f. in mV})^2}{0.0024} \text{ (pW).}$$

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1) With the exception of the hypothetical reference circuits for satellite systems and for circuits of 5000 km.

2) The number is not specified for the tropospheric-scatter radio-relay systems.

References

[1] CCITT Recommendation *4-MHz valve-type systems on standardized 2.6/9.5-mm coaxial cable pairs,* Orange Book, Vol. III-l, Rec. G.338, ITU, Geneva, 1977.

[2] CCIR Recommendation *Hypothetical reference circuit for radio-relay systems for telephony using frequency-division multiplex with a capacity of 12 to 60 telephone channels,* Vol. IX, Rec. 391, Dubrovnik, 1986.

[3] CCIR Recommendation *Hypothetical reference circuit for radio-relay systems for telephony using frequency-division multiplex with a capacity of more than 60 telephone channels,* Vol. IX, Rec. 392, Dubrovnik, 1986.

[4] CCIR Recommendation *Hypothetical reference* circuit *for trans-horizon radio-relay systems for telephony using frequency-division multiplex,* Vol. IX, Rec. 396, Dubrovnik, 1986.

[5] CCIR Recommendation *Hypothetical reference circuits for telephony and television in the fixed satellite service,* Vol. IV, Rec. 352, Dubrovnik, 1986.