INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.229

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INTERNATIONAL ANALOGUE CARRIER SYSTEMS

GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS

UNWANTED MODULATION AND PHASE JITTER

ITU-T Recommendation G.229

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.229 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.229

UNWANTED MODULATION AND PHASE JITTER

(Geneva, 1972, further amended)

1 Unwanted modulation by harmonies of the power supply and other low frequencies

1.1 *Requirements on carrier transmission systems*

To enable the limit indicated in the Recommendation cited in [1] to be met, it is recommended that a minimum side component attenuation of 45 dB should be obtained when a signal is transmitted over a channel having the same composition as the 2500 km hypothetical reference circuit for the system concerned.

This limit is subdivided as indicated in §§ 1.2 and 1.3 below into allocations to terminal and to line equipment.

1.2 *Combined effect due to all translating equipment*

The combined effect due to all translating equipment on the hypothetical reference circuit should correspond to a minimum side component attenuation of 48 dB.

For each translating equipment, send and receive side taken separately, and measured at the signal output, a side component attenuation of at least 63 dB should be obtained under normal operating conditions. Under adverse power supply conditions a minimum of 60 dB should be met. It is expected that then an overall value of 48 dB, indicated above, will only rarely be exceeded.

Note - The above requirements are derived from the hypothetical reference circuits for the 4 MHz, 12 MHz and 60 MHz systems. The same figures may be applied to other systems provided that their hypothetical reference circuit does not differ significantly from those referred to above.

1.3 *Combined effects due to all line equipment*

The combined effects due to all line equipment on the hypothetical reference circuit should correspond to a minimum side component attenuation of 48 dB.

Line equipments can be subject to two types of interference which will cause side components on a transmitted signal:

- Effects from power supplies (for example, a residual mains frequency ripple may be superimposed on the d.c. power feeding current). These are potentially systematic on the complete length of the circuit.
- Effects from voltages caused by induction (for example, from railway traction currents). They are not expected to occur as systematically as the effects from the power supplies.

The influence caused by *power supply ripple* should be such that a minimum side component attenuation of 51 dB is observed for the combined effect of all line equipment on the hypothetical reference circuit. It is recommended that on a single power feeding section, the side component attenuation should not be less than 51 + 10 log k dB, where k is the number of power feeding sections on the hypothetical reference circuit.

Note - Based on the assumptions that some power feeding sections may be powered from battery supplies and that adverse cumulation over the full length of the hypothetical reference connection is unlikely, it can be expected that the limit of 51 dB will be observed with a high probability.

The influence caused by *induced voltages* should be such that a minimum side component attenuation of 51 dB is observed for the combined effects of all line equipment on the hypothetical reference circuit. However, voltages caused by induction vary considerably with time. The effect of a source of induction is very often confined to one power feeding section. It seems very unlikely that the induced voltage reaches its maximum value in more than one section at the same instant.

It is recommended that the r.m.s. value of the longitudinal voltage in a power feeding section caused by induction under normal operating conditions (excluding short circuits and arcing on railways, etc.) should not exceed 150 volts. (This limit has been recommended regarding safety aspects and is contained in [2]. It seems reasonable to adopt the same value for the present purpose.)

Calculations indicate that an allowance of 6 dB for the combined effect of several sections under the influence of induction should cover the majority of likely cases. It is therefore recommended that a minimum side component attenuation of 57 dB should be observed on a power feeding section under the influence of the maximum allowed induced voltage. It is estimated that then the value of 51 dB on a circuit of 2500 km would only be exceeded in rare circumstances and infrequently, particularly in view of the fact that only a fraction of the total length would be exposed to interference by induction.

2 Phase jitter due to translating equipments

For each translating equipment, send and receive sides taken separately, a phase jitter on a signal should not exceed 1° peak-to-peak when measured on the output of the equipment. The measurement should be of all phase jitter components on each side of the signal in the frequency band 20-300 Hz, i.e. equivalent to the frequency band indicated in Recommendation O.91 [3].

Note 1 - The above requirement is derived from a consideration of data signals on a telephone-type circuit over a 2500-km hypothetical reference circuit. Conforming to this requirement will ensure a high probability that the overall phase jitter from this source will not exceed 6° peak-to-peak. This performance will also ensure a high probability that for telephone speech transmission the phase jitter will be below the detection threshold of a majority of listeners.

Note 2 - In practice it is expected that phase jitter of the magnitude given above will occur only on translating equipments using high frequency carriers and that correspondingly lower phase jitter will be caused by translating equipment using lower frequency carriers.

Note 3 - Where the phase jitter is caused mainly by random noise a peak-to-peak/r.m.s. ratio of 10 should be assumed.

References

[1] CCITT Recommendation *General performance objectives applicable to all modern international circuits and national extension circuits*, Vol. III, Rec. G.151, § 7.

[2] CCITT manual *Directives concerning the protection of telecommunication lines against harmful effects from electricity lines*, Chapter IV, §§ 6, 7 and 71, ITU, Geneva, 1963, 1965, 1974, 1978.

[3] CCITT Recommendation *Essential clauses for an instrument to measure phase jitter on telephone circuits*, Vol. IV, Rec. O.91.