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G.228

INTERNATIONAL ANALOGUE CARRIER SYSTEMS GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS

MEASUREMENT OF CIRCUIT NOISE IN CABLE SYSTEMS USING A UNIFORM - SPECTRUM RANDOM NOISE LOADING

ITU-T Recommendation G.228

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.228 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.228

MEASUREMENT OF CIRCUIT NOISE IN CABLE SYSTEMS USING A UNIFORM-SPECTRUM RANDOM NOISE LOADING

(Geneva, 1964; further amended)

The CCITT,

considering that

(a) it is desirable to measure the performance of cable systems for frequency-division multiplex telephony under conditions closely approaching those of actual operation;

(b) a signal with a continuous uniform spectrum (white noise) has statistical properties similar to those of a multiplex signal when the number of channels is not too small;

(c) the use of a signal with a continuous uniform spectrum to measure the performance of such cable systems is already widespread;

(d) it is necessary to standardize the frequencies and bandwidths of the measuring channels to be used for such measurements;

(e) for reasons of international compatibility it is necessary to standardize the minimum attenuation and the bandwidth of the stop filters which may have to be used in the white-noise generator;

(f) the CCITT has indicated, for the planning of telephone circuits, a mean value of signal power in the baseband of a multiplex telephone system to be taken into consideration during the busy hour (Recommendation G.223),

recommends that

1 The performance of frequency-division multiplex cable systems should be measured by means of a signal with a continuous uniform spectrum in the frequency band used for the telephone channels.

2 The nominal power level of the uniform spectrum test signal should be in accordance with the conventional load, specified in Recommendation G.223. If applied at the point of interconnection of the system corresponding to T' of Recommendation G.213, the absolute power levels of interest are shown in column 4 of Table 1/G.228.

2.1 The sending equipment should be capable of providing, at the output of an inserted bandstop filter, a loading level at least up to + 10 dB relative to the nominal power level defined above.

2.2 Within the bandwidth corresponding to the baseband of the system under test, the r.m.s. voltage of the white noise spectrum measured in a band of about 2 kHz should not vary by more than ± 0.5 dB. This degree of spectrum uniformity should be met in the level range up to +6 dB relative to the nominal power level, indicated in Table 1/G.228, column 4.

2.3 The white noise test signal should be available at the output of the sending equipment with a peak factor of about 12 dB with respect to the r.m.s. value.

3 The nominal effective cut-off frequencies (the cut-off frequencies of hypothetical filters having ideal square cut-off characteristics and transmitting the same power as the real filters) and tolerances for the bandpass filters proposed for the various bandwidths of systems to be tested, should be as specified in Table 2/G.228. To reduce the number of filters required, compromises have been made between the nominal effective cut-off frequency and the system bandwidth-limiting frequency in some cases. The tolerances ensure that consequent calibration errors do not exceed ± 0.1 dB and errors in measurement of intermodulation noise do not exceed ± 0.2 dB assuming system pre-emphasis of about 10 dB.

TABLE 1/G.228

1	2	3	4
Number of telephone channels	Relative power level at point T' (dBr)	Level of the conventional load (dBm0)	Nominal power level of the test signal at point T' (dBm)
60	-36	6.1	-29.9
120	-36	7.3	-28.7
300	-36	9.8	-26.2
600	-36 -33	12.8	-23.2 -20.2
960	-36 -33	14.8	-21.2 -18.2
1 260	-33	16.0	-17.0
1 800	-33	17.5	-15.5
2 700	-33	19.3	-13.7
3 600	-33	20.5	-12.5
10 800	-33	25.3	-7.7

TABLE 2/G.228

System capacity (channels)	Limits of band occupied by telephone channels (kHz)	Effective cut-off frequencies of bandpass filters (kHz)		Frequencies of recommended measuring channels (kHz)
		Highpass	Lowpass	
60	60- 300	60 ± 1	300 ± 2	70 270
120	60- 552	60 ± 1	552 ± 4	70 270 534
300 {	60- 1 300 64- 1 296	60 ± 1	$1\,296 \pm 8$	70 270 534 1 248
600 {	60- 2 540 64- 2 660	60 ± 1	$2\,600 \pm 20$	70 270 534 1 248 2 438
960 {	60- 4 028 64- 4 024	60 ± 1	$4\,100 \pm 30$	70 270 534 1 248 2 438 3 886
900	316- 4 188	316 ± 5	$4\,100 \pm 30$	534 1 248 2 438 3 886
1 260 {	60- 5 636 60- 5 564	60 ± 1	$5\,600 \pm 50$	70 270 534 1 248 2 438 3 886 5 340
1 200	316- 5 564	316 ± 5	$5\,600 \pm 50$	534 1 248 2 438 3 886 5 340
1 800 {	312- 8 120 312- 8 204 316- 8 204	316 ± 5	$8\,160 \pm 75$	534 1 248 2 438 3 886 5 340 7 600
2 700 {	312-12 336 316-12 388 312-12 388	316 ± 5	$12\,360 \pm 100$	534 1 248 2 438 3 886 5 340 7 600 11 700
3 600 {	316-17 004 312-16 900 596-17 668	316 ± 5	$17\,300 \pm 150$	534 or 770 1 248 2 438 3 886 5 340 7 600 11 700 16 400
10 800 {	4 332-59 684 4 404-59 580	$4\,370 \pm 70$	$59\,600 \pm 600$	5 340 11 700 35 748 55 548

3.1 The discrimination of a lowpass filter should be at least 20 dB at a frequency more than 10% above nominal cut-off and at least 25 dB at frequencies more than 20% above nominal cut-off. The discrimination of a highpass filter should be at least 25 dB at frequencies more than 20% below nominal cut-off.

3.2 To limit discrimination against measuring channels, the spread of losses introduced by any pair of highpass and lowpass filters should not exceed 0.2 dB over a range of frequencies which includes the upper and lower measuring channels.

4 Values of the characteristics for the discrimination in each stop-band at the output of a sending equipment are given in Table 3/G.228. These characteristics are intended to apply over a temperature range from 10 °C to 40 °C.

5 When the receiving equipment is connected directly to a sending equipment provided with bandstop filters which only just meet the requirements of § 4 above, the ratio of the noise power indicated by the receiving equipment when the bandstop filter is bypassed, to that indicated when the filter is in circuit, should be a minimum of 67 dB; this requirement applies when a conventional load is applied. The minimum effective bandwidth of the receiver should be 1.7 kHz; the maximum reading of absolute noise power arising from leakage given by a receiver of 1.74 kHz effective bandwidth and which just meets the foregoing leakage requirement is -85.6 dBm0p.

6 Additional measuring channels may be provided by agreement between the Administrations concerned.

Note - In Annexes A and B some general information is given on the measuring procedures, the choice of filter characteristics, correction methods and accuracy objectives.

TABLE 3/G.228

Characteristics of bandstop filters

Centre frequency f_0 (kHz)	Bandwidth (kHz), in relation to f_0 , over which the discrimination should be at least:				Bandwidth (kHz) in relation to f_0 , outside of which the discrimination should not exceed:	
	70 dB	55 dB	30 dB	3 dB	3 dB	0.5 dB
70	± 1.5	± 2.2	± 3.5	—	± 12	± 18
270	± 1.5	± 2.3	± 2.9	—	± 8	± 24
534	± 1.5	± 3.5	± 7.0	—	± 15	± 48
770	± 1.5	± 3.8	± 8.0	—	± 21	± 70
1 248	± 1.5	± 4.0	± 11.0	—	± 35	± 110
2 438	± 1.5	± 4.5	± 19.0	—	± 60	± 220
		± 15.0	± 30.0	—	± 110	± 350
3 886	± 1.5					
		± 1.8	± 3.5	± 8.0	± 12	± 100
5 340	± 1.5	± 2.2	± 4.0	± 8.5	± 14	± 150
7 600	± 1.5	± 2.4	± 4.6	± 9.5	± 16	± 200
11 700	± 1.5	± 3.0	± 7.0	± 11.0	± 20	± 300
16 400	± 1.5	± 4.0	± 9.0	± 14	± 30	± 500
35 748	± 1.8	± 2.2	± 3.5	± 5.0	± 20	± 150
55 548	± 2.5	± 3.5	± 6.0	± 9.5	± 30	± 200

Note 1 - The characteristics recommended for the filters 70 kHz to 2438 kHz inclusive are based on coil-capacitor type filters. Those characteristics recommended for the filters at 5340 kHz and above are based on crystal-type filters. Optional characteristics are recommended for the 3886-kHz filter to permit a choice of design between a coil-capacitor type or crystal-type filter. The crystal-type filters at 35 748 kHz and 55 548 kHz are assumed to be operating in a higher harmonic mode of the crystal resonators. That is why the relative bandwidths of these filters show a discontinuity compared with the crystal-type filters up to 11 700 kHz.