INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.227

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

INTERNATIONAL ANALOGUE CARRIER SYSTEMS

GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS

CONVENTIONAL TELEPHONE SIGNAL

ITU-T Recommendation G.227

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.227 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.

Recommendation G.227

CONVENTIONAL TELEPHONE SIGNAL

(Geneva, 1964; amended at Mar del Plata, 1968)

1 Principle

For the calculation or measurement of crosstalk noise between adjacent channels and, generally speaking, when it is desired to simulate the speech currents transmitted by a telephone channel[1)], the CCITT recommends that a conventional telephone signal be used, the main characteristic of which is a shaping network as a function of the frequency.

This network is defined by the following transfer coefficient as a function of the frequency:

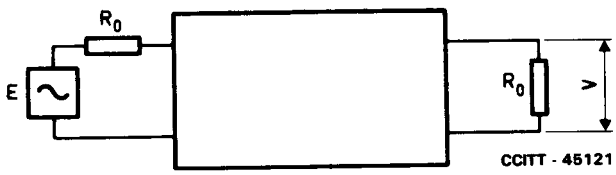


FIGURE 1/G.227

$$\frac{E}{2V} = \frac{18400 + 91238\,p^2 + 11638\,p^4 + p(67280 + 54050\,p^2)}{400 + 4001\,p^2 + p^4 + p\,(36040 + 130\,p^2)}$$

where $p = \mathrm{j}\,\frac{f(\mathrm{Hz})}{1000\ \mathrm{Hz}}$, E and V are defined by Figure 1/G.227.

The response curve of the network is shown in Figure 2/G.227, and an example of the design is given in Figure 3/G.227 with relevant values.

[1)] Care is needed in applying this conventional signal to simulate speech loading, since the statistics of a Gaussian noise signal and of real speech are different. A speech-simulating generator for loading purposes is given in [1].

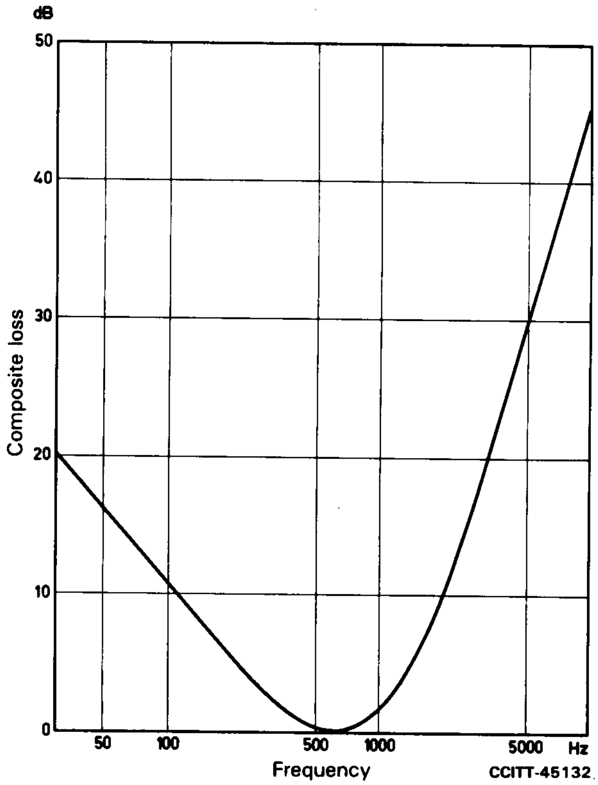
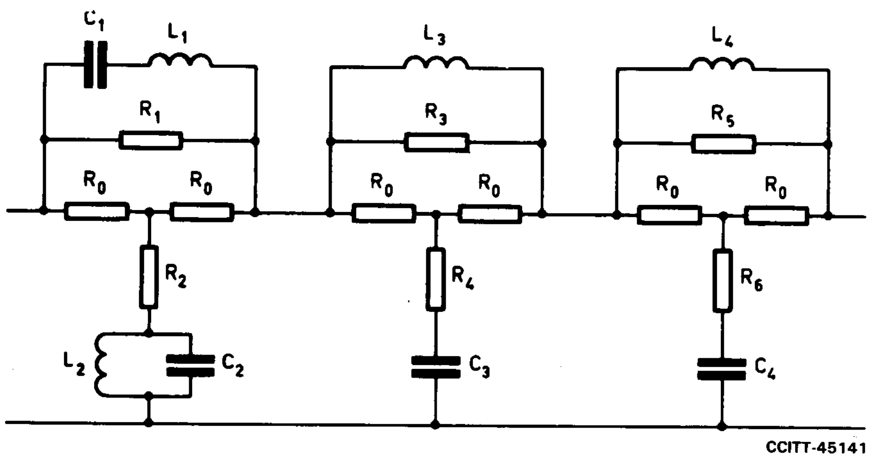


FIGURE 2/G.227

Relative response curve of the shaping network of the conventional telephone signal generator



Section 1	Section 2	Section 3
$\frac{R_1}{R_0} = 45$	$\frac{L_1 \omega_0}{R_0} = 0.5$	$R_0 C_1 \omega_0 = 2$
$\frac{R_2}{R_0} = 0.0222$	$\frac{L_2 \omega_0}{R_0} = 2$	$R_0 C_2 \omega_0 = 0.5$
$\frac{R_3}{R_0} = 10$	$\frac{L_3 \omega_0}{R_0} = 0.5$	$R_0 C_3 \omega_0 = 0.5$
$\frac{R_4}{R_0} = 0.1$	$\frac{L_4 \omega_0}{R_0} = 1.11$	$R_0 C_4 \omega_0 = 1.11$
$\frac{R_5}{R_0} = 22$		
$\frac{R_6}{R_0} = 0.0455$		

with $\omega_0 = 2\pi \times 10^3 \times \text{second}^{-1}$

FIGURE 3/G.227

Shaping network of the conventional telephone signal generator

2 Example of network design

The network is made up of three bridged *T* sections with a constant characteristic impedance equal to R_0 ohms.

Figure 3/G.227 represents the network and indicates the values of the various components normalized to R_0.

A tolerance of ± 1% can be allowed on the value of each component.

Note - If θ_1, θ_2, θ_3 are the "composite" transfer coefficients of sections 1, 2 and 3 respectively, we have:

$$\frac{E}{2\,V} = e^{\theta} = e^{\theta_1+\theta_2+\theta_3}$$

with $$e^{\theta_1} = \frac{46 + 90p + 46p^2}{1 + 90p + p^2}$$

$$e^{\theta_2} = \frac{20 + 11p}{20 + p}$$

$$e^{\theta_3} = \frac{20 + 23p}{20 + p}$$

with $$p = \mathrm{j}\,\frac{f(\mathrm{Hz})}{1000\ \mathrm{Hz}}$$

The minimum composite loss[2)] of the complete network lies in the vicinity of 600 Hz and equals $a_0 \sim 2.9$ dB for this example.

The curve in Figure 2/G.227 represents, as a function of frequency, the composite loss[2)] of the network in Figure 3/G.227 relative to the minimum loss a_0.

3 Signal at the network input

The network may be energized either by a uniform-spectrum random noise signal or by a closely spaced harmonic series. In the latter case, the following precautions are necessary:

1) Spacing of the harmonics should not exceed 50 Hz.

2) The measuring instrument must have an adequate integrating time with respect to the fundamental period of the harmonic series. Types of CCITT instruments in general use, such as the psophometer, are believed to be satisfactory in this respect.

3) The peak/r.m.s. ratio of the signal should not exceed 3.5. This requirement may be achieved, in the case of a particular generator, by means of an associated phase-changing network.

4) The energizing signals (uniform-spectrum random noise and harmonic series) could lead to different results for subjective, e.g. aural assessments at the receiving end, and such measurements should not, therefore, involve the use of the conventional telephone signal generator. That apparatus would be used solely for objective measurements, in which a psophometer served as measuring instrument.

Reference

[1] CCITT - Question 5/C, Annex 2, Green Book, Vol. III, ITU, Geneva, 1973.

2) Composite loss equals the insertion loss in this particular case since the source and the load impedances are equal.