RECOMMENDATION ITU-R F.405-1*

Pre-emphasis characteristics for frequency modulation radio-relay systems for television

(1959-1963-1970)

The ITU Radiocommunication Assembly,

considering

a) that it is generally preferable for the major intermediate-frequency and radio-frequency characteristics of international radio-relay systems for television to conform to those of large capacity systems for multi-channel telephony;

b) that the flexibility of radio-relay systems would be further increased if the modulators and demodulators could be used interchangeably for either television or frequency-division multiplex telephony;

c) that the high-level, low-frequency components in the video-frequency waveform, which are a barrier to the achievement of this flexibility, can be greatly reduced by attenuation of these components, i.e. by means of a pre-emphasis network before modulation, a corresponding de-emphasis network being inserted after demodulation;

d) that pre-emphasis enables a simple control of the mean carrier-frequency to be used both for television and frequency-division multiplex telephony;

e) that pre-emphasis can reduce differential gain and differential phase distortion in a radio-relay system and may be particularly advantageous if the transmission of colour television signals, or a sound channel by means of a sub-carrier, is envisaged;

f) that, in determining the pre-emphasis characteristic, its effect on the overall weighted signal-to-noise ratio** and on adjacent-channel interference must be taken into account;

g) that excessive attenuation of the low-frequency components of the video signal can cause difficulties due to hum and microphony;

h) that the optimum pre-emphasis characteristics for television and frequency-division multiplex telephony will not be the same;

j) that, to achieve readily reproducible characteristics, the pre-emphasis network, and the corresponding de-emphasis network, should be simple;

k) that it is operationally desirable that the same shape of pre-emphasis characteristic is used for monochrome and colour television signals,

recommends

1 that the use of pre-emphasis is preferred for the transmission of television signals by radio-relay systems;

2 that a minimum phase shift network should be used for pre-emphasis;

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* Radiocommunication Study Group 9 made editorial amendments to this Recommendation in 2001 in accordance with Resolution ITU-R 44.

** See ITU-T Recommendation J.61.

3 that the idealized preferred pre-emphasis characteristic be given by the expression:

$$\text{relative deviation (dB)} = 10 \log [(1 + Cf^2)/(1 + Bf^2)] - A \quad (1)$$

where:

A is the attenuation (dB) at a low frequency (< 0.01 MHz)

B and C are constants which determine the shape of the pre-emphasis characteristic

f is the frequency (MHz).

The preferred values of A, B and C for 525-, 625-, and 819-line systems are shown in Table 1. The shapes of the characteristics are shown in Fig. 1;

TABLE 1

Values of coefficients of pre-emphasis characteristics

Number of lines	525	625	819
A	10.0	11.0	7.0
B	1.306	0.4083	0.1021
C	28.58	10.21	2.552
Cross-over frequency (MHz) . . .	0.7616	1.512	1.402
Deviations (peak-to-peak) at low frequencies (MHz)	2.530	2.255	3.573

4 that the tolerance on the pre-emphasis characteristics, and also on the de-emphasis characteristics referred to in Note 2, should be such that, within the frequency range of 0.01 MHz to the nominal upper limit of the video-frequency band, the departure of the characteristic of a practical network from the appropriate theoretical characteristic should be confined within a variation of $\pm(0.1 + 0.05\, f/f_c)$ dB, f being the video-frequency, f_c being the nominal upper limit of the video-frequency band. This corresponds to tolerances of the network components (resistors, capacitors, inductors) of about ±1%. Further, the magnitude of the departure should exhibit no rapid variations within this frequency range.

NOTE 1 – In accordance wih Recommendation ITU-R F.276 and ITU-T Recommendation J.61, a peak-to-peak signal of 1 V at a point of video-frequency interconnection produces, in the absence of pre-emphasis, a peak-to-peak deviation of 8 MHz. When there is pre-emphasis, a sinusoidal wave of 1 V peak-to-peak at a video-frequency corresponding to 0 dB relative deviation (cross-over frequency) produces a peak-to-peak deviation of 8 MHz. The cross-over frequencies are shown in Table 1. At a low frequency (< 0.01 MHz) the corresponding deviation is reduced in accordance with the factor A. These low frequency deviations are also shown in Table 1.

NOTE 2 – When television signals are to be transmitted between countries with radio-relay systems designed for different numbers of lines, the administration of the country receiving the signals should provide de-emphasis networks corresponding to the pre-emphasis network of the originating country; however, if preferred, other arrangements may be adopted by agreement between the administrations concerned.

NOTE 3 – An example of a pre-emphasis network is shown in Table 2 and Fig. 2. Table 3 and Fig. 3 give an example of a corresponding de-emphasis network.

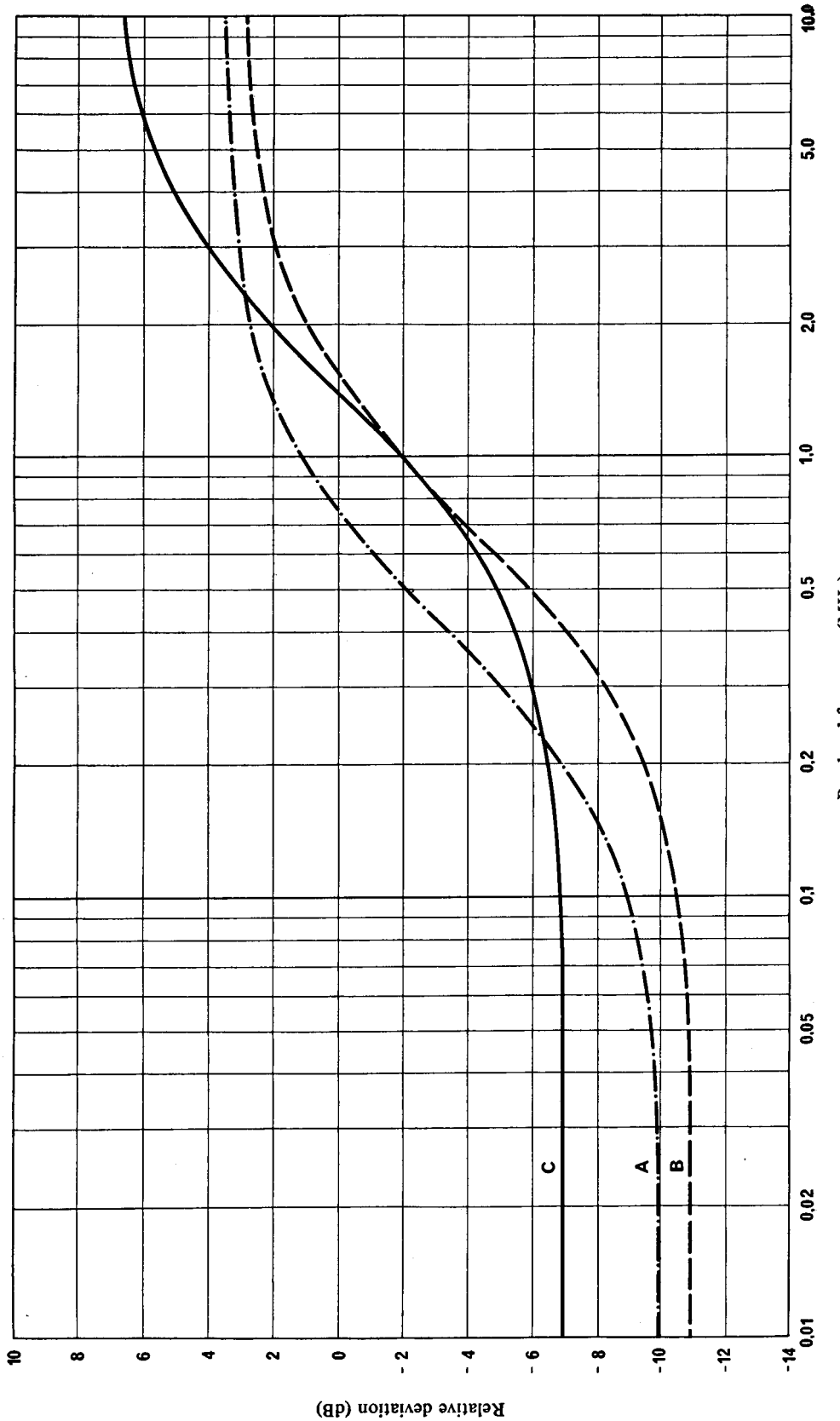

FIGURE 1

Pre-emphasis characteristic for television on 525-, 625-, and 819-line systems

Curve A: 525-line system
B: 625-line system
C: 819-line system

TABLE 2

Component values of pre-emphasis network for television

Number of lines	525	625	819
L(μH)	17.35	9.54	4.77
C(pF)	3085	1695	847.5
R_1 (Ω)	275.8	300	300
R_2 (Ω)	75	75	75
R_3 (Ω)	20.4	18.75	18.75

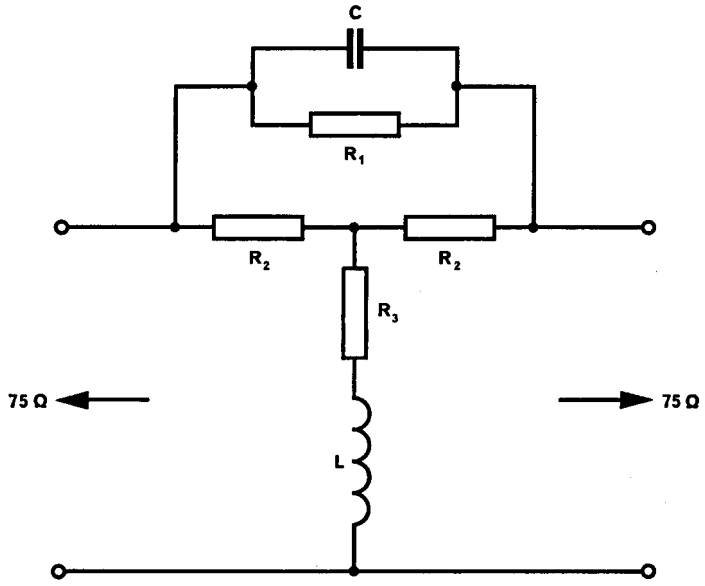

FIGURE 2

Pre-emphasis network for television

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TABLE 3

Component values of de-emphasis network for television

Number of lines	525	625	819
L(μH)	50.16	30.53	15.26
C(pF)	8917	5424	2712
R_1 (Ω)	275.8	300	300
R_2 (Ω)	75	75	75
R_3 (Ω)	20.4	18.75	18.75

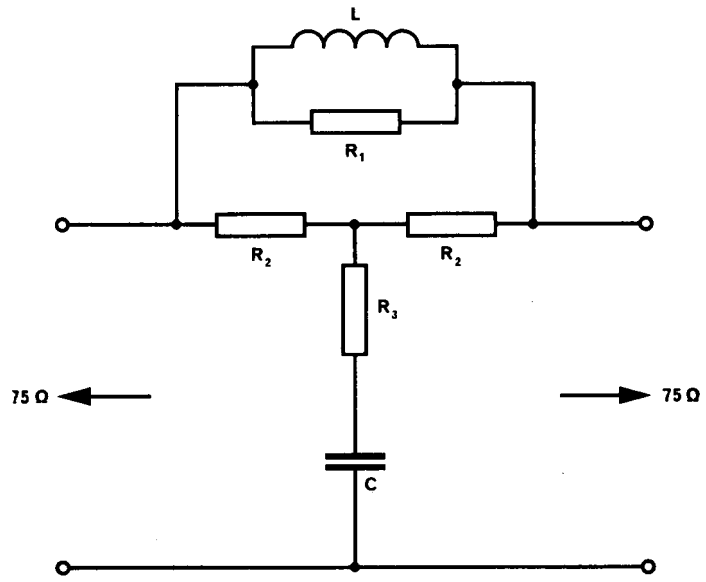

FIGURE 3

De-emphasis networks for television

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