INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

J.64

(ex CMTT.569)

(05/86)

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

TELEVISION AND SOUND TRANSMISSION

DEFINITIONS OF PARAMETERS FOR SIMPLIFIED AUTOMATIC MEASUREMENT OF TELEVISION INSERTION TEST SIGNALS

ITU-T Recommendation J.64

(Formerly Recommendation ITU-R CMTT.569)

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation J.64 (formerly Recommendation ITU-R CMTT.569) was elaborated by the former ITU-R Study Group CMTT. See Note 1 below.

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector (ITU-R).

Conforming to a joint decision by the World Telecommunication Standardization Conference (Helsinki, March 1993) and the Radiocommunication Assembly (Geneva, November 1993), the ITU-R Study Group CMTT was transferred to ITU-T as Study Group 9, except for the satellite news gathering (SNG) study area which was transferred to ITU-R Study Group 4.

2 In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation J.64[1)]

DEFINITIONS OF PARAMETERS FOR SIMPLIFIED AUTOMATIC MEASUREMENT OF TELEVISION INSERTION TEST SIGNALS

(1978; revised in 1982 and 1986)

The CCIR,

CONSIDERING

(a) that Recommendation 567 is the basic reference which defines the parameters which are to be measured and the test signal elements and measuring methods which are to be used, in order to determine the performance of a television transmission circuit;

(b) that Reports 628 and 411 describe various techniques for automatic measurement and monitoring of the performance of television chains which make use of insertion test signals;

(c) that operational measurements are commonly carried out using insertion test signals which are defined in Recommendation 473;

(d) that Report 314 describes the allocation of lines in the field-blanking interval for special purposes;

(e) that, although automatic measuring equipment exists that can make measurements in accordance with Recommendation 567, simplified automatic measuring equipment also exists that requires modifications of the measurement methods and definitions;

(f) that such simplified automatic measurement of insertion test signals suits the requirements of operational staffs and makes the analysis of measurement results easier,

UNANIMOUSLY RECOMMENDS,

that, when simplified automatic measuring equipment is used to make measurements of an insertion test signal, and when a normalized form of presentation of the results is desired, the definitions used in quantifying the parameters of that signal should be those which are given in Annex I.

ANNEX I

1. Introduction

The need for each of the measurements described in this Recommendation (and possibly other measurements) will depend upon the type of plant in use and the policy of the administrations.

The test signals specified are those shown in Recommendation 473.

The definitions assume that the performance of the measuring equipment employed is such that any harmonic components of the incoming signal, occurring above the nominal video band, will not give rise to measurement errors which exceed the specified accuracy of that equipment. The definitions also assume instrumentation that will substantially eliminate the effects of any noise present on the incoming signal from the measurement of any test signal parameter.

The magnitude of distortions exhibited by signals which have passed through a non-linear transmission circuit tend to vary with average picture level. Therefore it may be desirable also, to measure automatically the value of Average Picture Level (APL) associated with any particular magnitude of distortion or error.

[1)] Formerly Recommendation ITU-R CMTT.569.

2. Definitions

2.1 *Luminance bar amplitude*

The luminance bar amplitude is defined as the difference between the level corresponding to the mid-point of the bar (element B_2) and the level corresponding to a point immediately following the composite pulse (element *F*). These points are shown as b_2 and b_1 respectively in Figs. 1 and 2. It is to be expressed as a percentage of the nominal bar amplitude (0.7 V for 625-line signals, 0.714 V for 525-line signals).

2.2 *Luminance bar amplitude error*

The luminance bar amplitude error is defined as the difference between the actual luminance bar amplitude and the nominal value expressed as a percentage of the nominal value (0.7 V for 625-line signals, 0.714 V for 525-line signals).

2.3 *Bar tilt*

The luminance bar tilt is defined as the difference between the level of the luminance bar one microsecond after the half amplitude point of its leading edge (point b_3 in Figs. 1 and 2), and the level one microsecond before the half amplitude point of its trailing edge, (point b_4 in Figs. 1 and 2) expressed as a percentage of the luminance bar amplitude. The sign of the difference is positive if b_4 is higher than b_3.

Note. – The parameter bar tilt as defined above is a unique measurement by automatic devices of a specific form of line time waveform distortion, i.e. the difference in the level of the line bar at two specific reference points. This measurement is different to the measurements of line time waveform distortion described in Recommendation 567 (§ C.3.5.1.3 and Annex III to Part C, § 2.1) where the maximum difference in level at any point between defined reference points is measured.

2.4 *Base-line distortion*

The base-line distortion is defined as the difference between the levels of the signal at point b_7, which is located after the mid-amplitude point of the trailing edge of the bar (element B_2) at a distance of 400 ns for 625-line systems and 500 ns for 525-line systems (see Figs. 1 and 2), and at a reference point b_1 located before the beginning of the staircase in line 17 (see also Figs. 1 and 2).

The base-line distortion is expressed as a percentage of the luminance bar amplitude. It is to be measured after the bandwidth of the signal has been limited (see Note). The sign of the difference is positive if the signal level at point b_7 is higher than the level of reference point b_1.

Note. – Limitation may be achieved by the use of a network, the design of which is based on "Solution 3" [Thomson, 1952], having its first zero at 3.3 MHz, or by an equivalent technique.

2.5 *2T pulse/bar ratio error*

The 2*T* sine-squared pulse/bar ratio error is defined as the difference between the amplitudes of the 2*T* pulse (element B_1) and the luminance bar (element B_2), expressed as a percentage of the luminance bar amplitude. The peak amplitude of the 2*T* pulse is referred to a reference point b_1 (see Note) (Figs. 1 and 2) before the first riser of the staircase. The sign of the difference is positive if the 2*T* pulse amplitude is greater than the luminance bar amplitude.

Note. – To avoid error due to line tilt, it may be preferable to use a reference point exclusively for the measurement of 2*T* pulse/bar ratio error, which is defined to be the linear mean level of the insertion test signal during the periods: 2 to 1 µs before, and 1 to 2 µs after the 2*T* pulse.

2.6 *2T pulse shape distortion*

This definition requires further study.

2.7 *Chrominance-luminance gain inequality*

The chrominance-luminance gain inequality is defined as the difference between the peak-to-peak amplitude of the chrominance component of the element *G*, G_1, G_2 and the amplitude of the luminance bar (element B_2) expressed as a percentage of the luminance bar amplitude. The sign of the difference is positive if the amplitude of the chrominance component is greater than that of the luminance bar. Note that in the 525-line case the nominal amplitude of element *G* is 80 IRE units. This factor must be taken into account when normalizing results.

If for any reason signal elements *G*, G_1 or G_2 are not available, the measurement can be made with the chrominance component of element *F*.

2.8 *Chrominance-luminance delay inequality*

The chrominance-luminance delay inequality is defined as the time difference (expressed in ns) between the luminance and the chrominance component of the composite pulse (element F). This difference is positive, if the symmetry axis of the demodulated chrominance component lags behind the symmetry axis of the luminance component.

2.9 *Luminance non-linearity*

The luminance non-linearity is to be measured with the staircase signal in line 17 (element D_1 for 625-lines, D_2 for 525-lines). It is defined as the difference between the largest and the smallest step amplitudes, expressed as a percentage of the amplitude of the largest step. As the sign of the difference is not significant it is taken to be positive.

2.10 *Differential gain*

Differential gain is determined by evaluating the amplitude modulation of the colour sub-carrier superimposed on the staircase in element D_2.

Recommendation 567 defines differential gain in terms of two parameters $+x$ and $–y$ which represent the maximum (peak) differences in amplitude between the sub-carrier on the treads of the received test signal and the sub-carrier on its blanking level, expressed as a percentage of the latter. In the case of a monotonic characteristic, either x or y will be zero.

x and y can be found from the expressions below:

$$x = 100 \left| \frac{A_{max}}{A_0} - 1 \right| \qquad y = 100 \left| \frac{A_{min}}{A_0} - 1 \right|$$

where:

A_0 : amplitude of the received sub-carrier on the blanking level tread of element D_2.

A_{max} : highest value of sub-carrier on any tread.

A_{min} : lowest value of sub-carrier on any tread.

Two alternative methods of expressing the results are acceptable for automatic measurement. These are:

(a) "peak differential gain", which is defined by either $+x$ or $–y$, depending upon which of these parameters has the larger magnitude.

(b) "peak-to-peak differential gain", which is defined as $x + y$.

Note. – For the measurement of peak-to-peak differential gain some administrations use A_{max} rather than A_0. The formula used then is:

$$x + y = 100 \left| \frac{A_{max} - A_{min}}{A_{max}} \right|$$

Results obtained by this method will differ only slightly from those defined above if the magnitude of the distortion is not excessive.

2.11 *Differential phase*

Differential phase is determined by evaluating the phase modulation of the colour sub-carrier superimposed on the staircase in element D_2: (Fig. 5: 625-lines; Fig. 2: 525-lines).

Recommendation 567 defines differential phase in terms of two parameters $+x$ and $–y$ which represent the maximum (peak) differences in phase between the sub-carrier on the treads of the received test signal and the sub-carrier on its blanking level, expressed in degrees difference from the latter. In the case of a monotonic characteristic either x or y will be zero.

x and y can be found from the expressions below:

$$x = \left| \Phi_{max} - \Phi_0 \right| \qquad y = \left| \Phi_{min} - \Phi_0 \right|$$

where:

Φ_0 : phase of sub-carrier on the blanking level tread of element D_2.

Φ_{max} : highest value of sub-carrier phase on any tread.

Φ_{min} : lowest value of sub-carrier phase on any tread.

Two alternative methods of expressing the results are acceptable for automatic measurement. These are:

(a) "peak differential phase", which is defined by either $+x$ or $-y$ depending upon which of these parameters has the larger magnitude.

(b) "peak-to-peak differential phase", which is defined as $x + y$.

2.12 *Chrominance-luminance intermodulation*

The chrominance-luminance intermodulation is measured on element G, G_1 or G_2, after suppressing the incoming colour sub-carrier. It is defined as the difference between the luminance amplitude in element G_1, or in the last section of element G or G_2 (b_5 in Figs. 3 and 4) and the amplitude of the succeeding section (b_6 in Figs. 3 and 4) in which the test signal has no sub-carrier, expressed as a percentage of the amplitude of the luminance bar (element B_2). The sign of the difference is positive if the luminance amplitude b_5 is greater than the luminance amplitude of the succeeding section b_6.

Note. – Some administrations use element F instead of G, G_1 or G_2 for measurement of this parameter. In this case measurement of the amplitude of the luminance component of the composite pulse (element F) is made after suppressing the incoming colour sub-carrier. The result will be given by the difference between the composite pulse luminance amplitude and half the luminance bar amplitude, expressed as a percentage of the luminance bar amplitude. The sign of the difference is positive if the amplitude of the composite pulse component is greater than half the luminance bar amplitude. In some cases the result may differ from that given by the preferred method, since the signal element F is not so well suited as element G to the measurement of this distortion.

2.13 *Two-level chrominance amplitude non-linearity*

This parameter is to be measured with element G or G_2. Its value, expressed in per cent, and with a sign, is defined by:

$$\frac{(V_3 - 5V_1)}{V_3} \times 100 \text{for 625-line signals}$$

$$\frac{(V_3 - 4V_1)}{V_3} \times 100 \text{for 525-line signals}$$

where V_1 and V_3 are respectively the peak-to-peak amplitudes of the first and last sections of element G or G_2.

2.14 *Two-level chrominance phase non-linearity*

This parameter is to be measured with element G or G_2. Its value, expressed in degrees, and with a sign, is defined by:

$$\Phi_3 - \Phi_1$$

where Φ_3 and Φ_1 are respectively the phases of the last and first sections of element G or G_2.

2.15 *Signal-to-random noise ratio*

2.15.1 *Signal-to-unweighted random noise ratio*

The signal-to-unweighted random noise ratio is defined as the ratio of the amplitude of the luminance bar (element B_2) to the r.m.s. value of the noise measured on a specified line, or part of this line, (line 22, or optionally both lines 22 and 335, in the case of 625-line signals). It is to be given in dB. The noise bandwidth is assumed to be limited by the low pass filter defined in Recommendation 567 Annex II to Part C. Lower frequency limiting shall be done by a 200 kHz high pass filter with a slope of 20 dB per decade (see Note).

To suppress any periodic noise at sub-carrier frequency, a notch filter should be used (see Note).

For 625-line signals, the amplitude/frequency response of the filter should be as in Fig. 8 and a possible implementation of the filter as a constant impedance network is given in [CCIR, 1978-82a].

Note. – The upper limit of the noise bandwidth is selected so as to eliminate noise which occurs outside of the wanted band of the video signal. The high pass filter and the notch filter are used to minimize the effects of periodic noise at low frequencies and at the sub-carrier frequency, respectively. The high pass filter has also been specified to minimize the measurement errors caused by residual wave-form distortion in the measurement period.

Attention is directed to the fact that the high pass filter and the notch filter modify the spectral composition of the random noise and therefore alter its r.m.s. or quasi peak-to-peak value. The conversion factors in dB established for noise with a spectrum ideally limited to 5 MHz are given in Table I (see also [CCIR, 1978-82b]).

2.15.2 *Signal-to-weighted random noise ratio*

The signal-to-weighted random noise ratio is defined as in § 2.15.1 above, save for the addition of the unified weighting network specified by the CCIR in Recommendation 567.

2.15.3 *Signal-to-quasi peak-to-peak noise ratio*

The signal-to-quasi peak-to-peak noise ratio is defined as the ratio of the amplitude of the luminance bar (element B_2) to the value exceeded by the noise voltage deviation for a specified measurement time percentage (see Notes 1 and 2). It may be measured both under weighted or unweighted conditions. The comparison between these parameters and that defined in § 2.15.1 and 2.15.2 is intended to confirm the Gaussian nature of the noise. They are to be given in dB.

Note 1. – The upper limit of the noise bandwidth is selected so as to eliminate noise which occurs outside of the wanted band of the video signal. The high pass filter and the notch filter are used to minimize the effects of periodic noise at low frequencies and at the sub-carrier frequency, respectively. The high pass filter has also been specified to minimize the measurement errors caused by residual wave-form distortion in the measurement period.

Attention is directed to the fact that the high pass filter and the notch filter modify the spectral composition of the random noise and therefore alter its r.m.s. or quasi peak-to-peak value. The conversion factors in dB established for noise with a spectrum ideally limited to 5 MHz are given in Table I (see also [CCIR, 1978-82b]).

Note 2. – Further study is required to specify this percentage.

2.16 *Signal-to-chrominance periodic noise ratio*

This parameter is to be measured on the part of the signal used in § 2.15 above. It is defined as the ratio of the amplitude of the luminance bar (element B_2) to the peak-to-peak amplitude of spurious signals in a total 3 dB bandwidth of 0.2 MHz centred on the appropriate colour sub-carrier frequency as in § 2.15 above. The result of the measurement is to be given in dB.

2.17 *Low-frequency errors*

This parameter is defined as the peak-to-peak amplitude of the fluctuations of the blanking level, measured in a frequency band from 10 Hz to 2 kHz, and expressed as a percentage of the amplitude of the luminance bar (element B_2). Further information is given in [CCIR, 1974-78].

2.18 *Sync. amplitude error*

Sync. amplitude error is defined as the difference between sync. amplitude and its normalized value (i.e. 3/7 luminance bar amplitude for 625-lines, 4/10 luminance bar amplitude for 525-lines) (see Note 1) expressed as a percentage of the normalized value. The sign of the difference is positive if sync. pulses are larger than the normalized value.

To provide a measurement result in the presence of sound-in-syncs signals, sync. amplitude must be measured at the mid-point of the last broad pulse of each field (point b_8 in Fig. 6) (see Note 2).

Note 1. – The luminance bar amplitude is defined in § 2.1.

Note 2. – To avoid error due to field tilt it may be preferable to use a reference point exclusively for the measurement of sync. amplitude error which is placed at point b_9 in Fig. 6 of each field.

2.19 *Chrominance reference amplitude error*

This parameter relates to the variation in amplitude of the colour sub-carrier occurring in the region of blanking level. It is defined as the difference between the peak-to-peak amplitude of the colour sub-carrier on the blanking level tread of element D_2 and its normalized value, (i.e. 4/10 luminance bar amplitude) (see § 2.18, Note 1), expressed as a percentage. The sign of the difference is positive if the amplitude of the colour sub-carrier on the blanking level tread is larger than the normalized value.

2.20 *Gain/frequency characteristic*

2.20.1 *Peak ripple of the multi-burst signal*

This quantity is defined on the basis of two numbers *x* and *y*, which represent the maximum (peak) differences between the amplitudes of the bursts of the test signal *C* (see Note 1) and a reference quantity A_0, the two numbers *x* and *y* being expressed as a percentage of A_0.

For 625-line signals, A_0 is the peak-to-peak amplitude of element C_1 (see Fig. 7).

For 525-line signals, A_0 is equal to half the amplitude of the luminance bar, as defined in § 2.1 above (see Note 2).

x and *y* can be found from the following expressions:

$$x = 100 \left| \frac{A_{max}}{A_0} - 1 \right| \qquad y = 100 \left| \frac{A_{min}}{A_0} - 1 \right|$$

where A_{max} and A_{min} are respectively the highest and the lowest value of the peak-to-peak amplitude of the relevant bursts (see Note 3) measured at their half duration point.

The peak ripple of the multi-burst signal is defined by either $+x$ or $-y$ depending upon which of these parameters has the larger magnitude.

Note 1. – For 625-line signals, the last burst (having a frequency of 5.8 MHz), is not taken into account in this measurement.

Note 2. – Further study is required to check if, as an alternative, A_0 may also be derived from test element C_1.

Note 3. – For 625-line signals, the last burst (having a frequency of 5.8 MHz), is not taken into account in this measurement.

2.20.2 *Amplitude error of the burst at n MHz* (see Note)

This quantity is defined as the difference in terms of magnitude and sign between the peak-to-peak amplitude of the burst at *n* MHz and the reference quantity A_0 (defined as above), expressed as a percentage of A_0.

Note. – *n* is the designation of the frequency of the burst taken into account. Note 1 of § 2.20.1 also applies here.

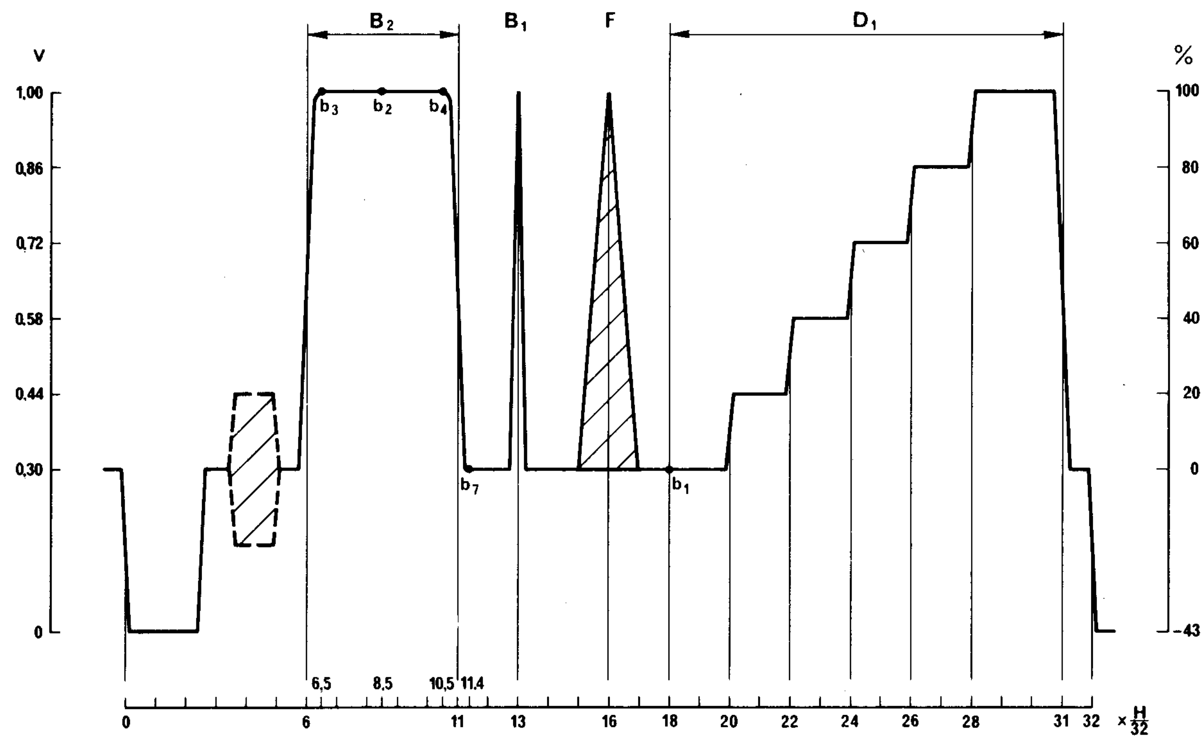

FIGURE 1 – *Line 17 for 625-line systems*

d01-sc

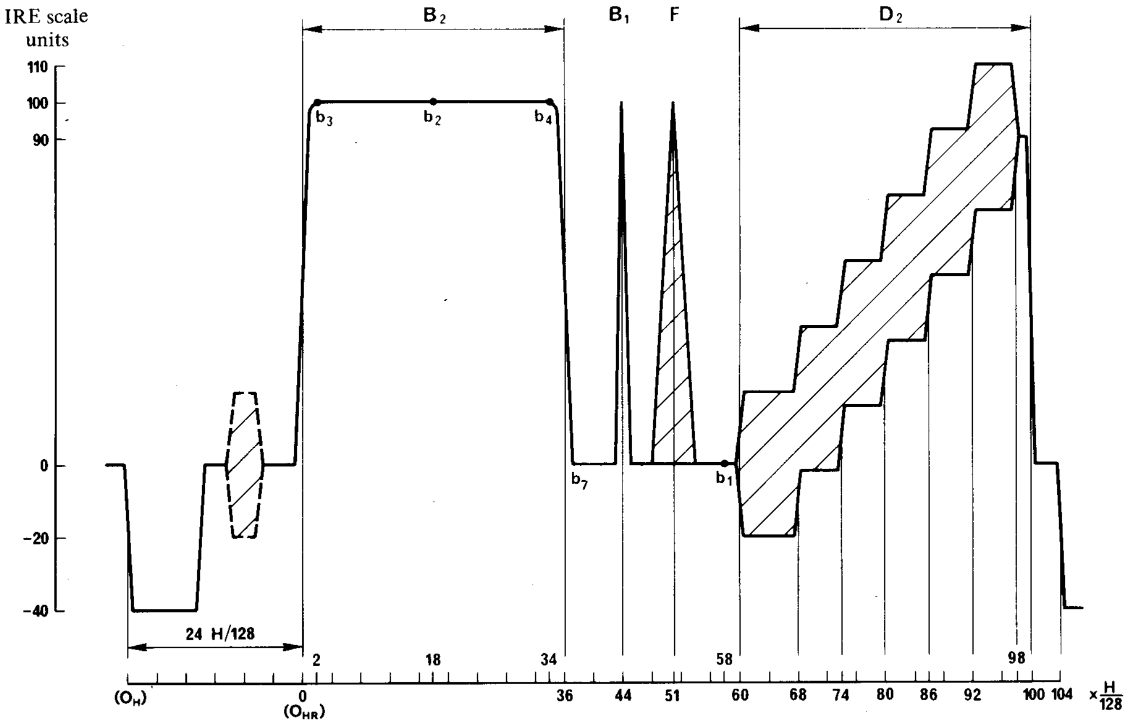

FIGURE 2 – *Line 17 of field 1 for 525-line systems*

Note. – The majority of the administrations reserve line 17 for insertion of international test signals. Report 314 provides information on the current allocation of lines reserved for special signals.

d02-sc

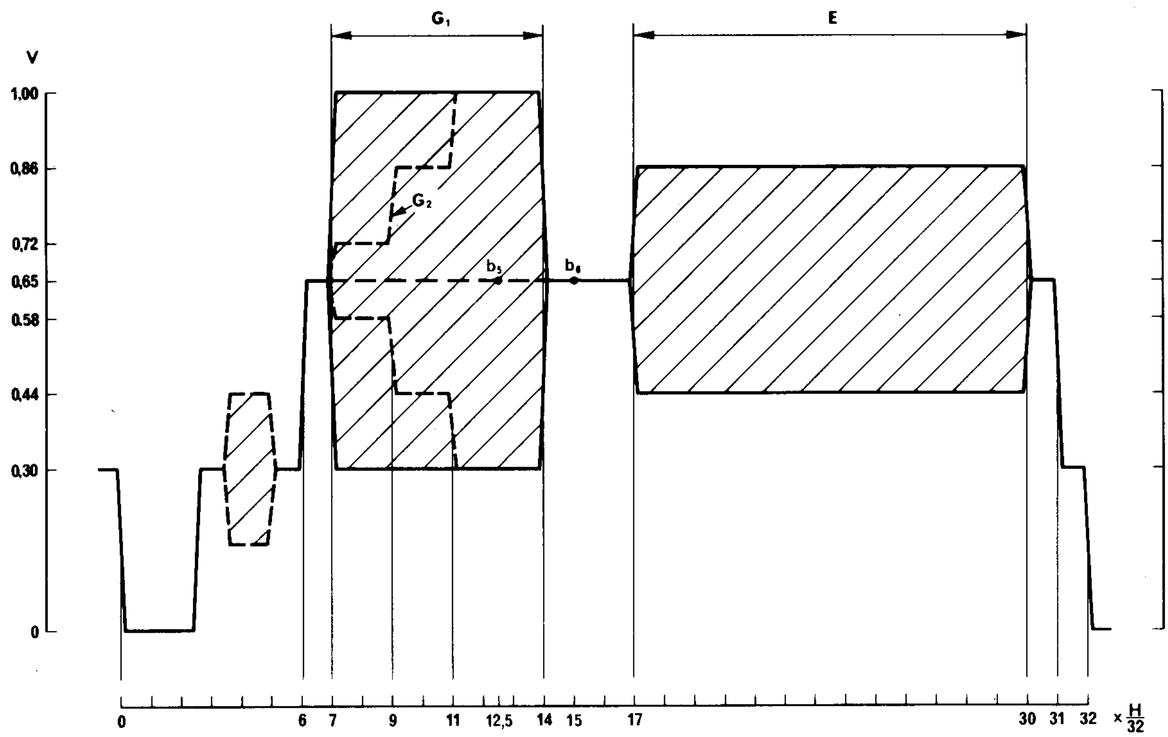

FIGURE 3 – *Line 331 for 625-line systems*

d03-sc

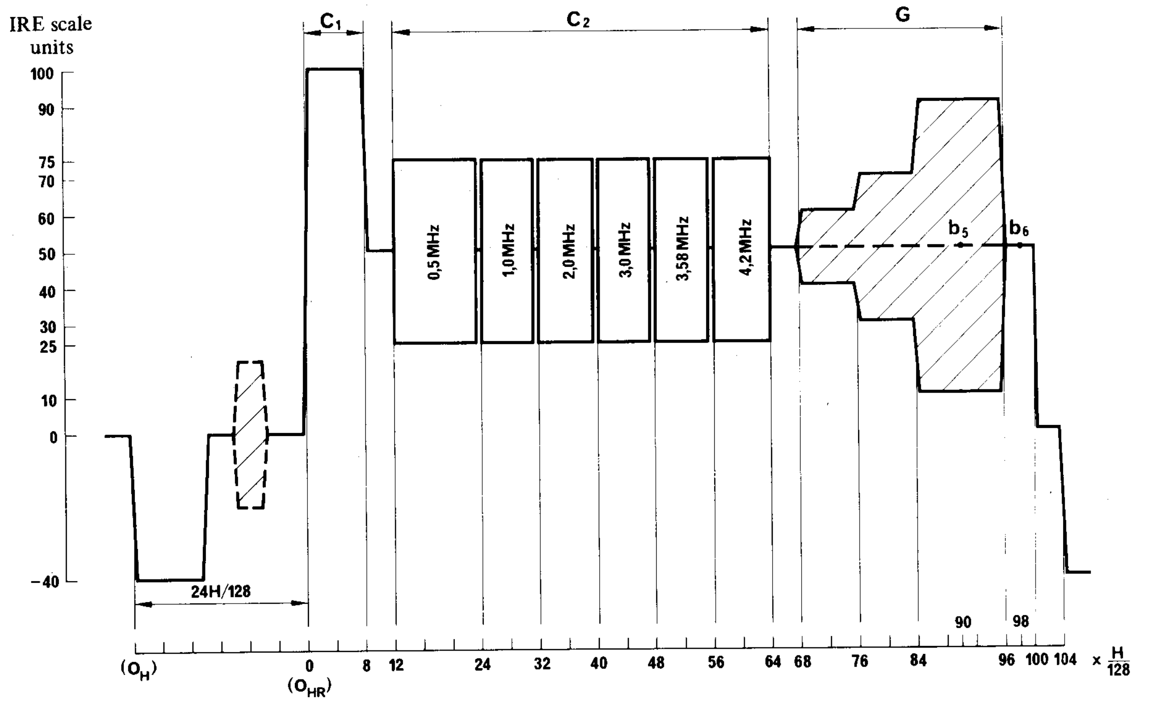

FIGURE 4 – *Line 17 of field 2 for 525-line systems*

Note. – The majority of the administrations reserve line 17 for insertion of international test signals. Report 314 provides information on the current allocation of lines reserved for special signals.

d04-sc

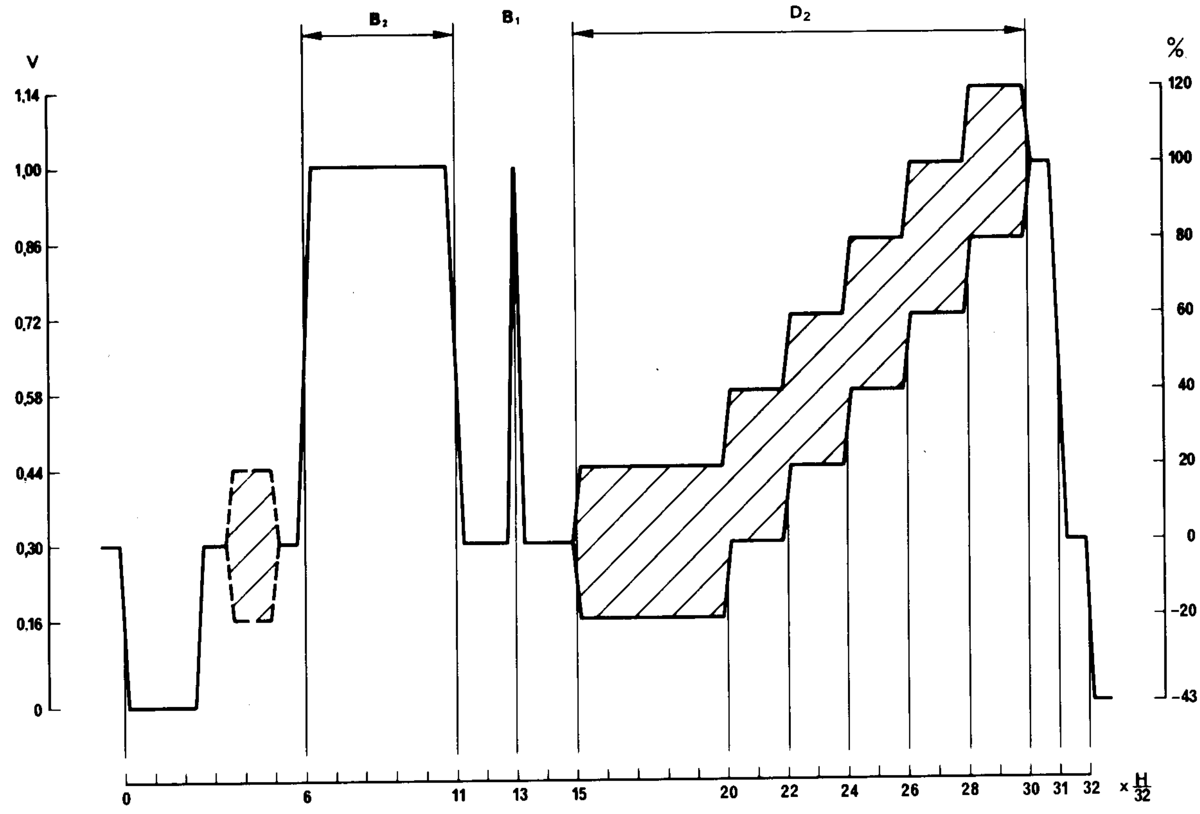

FIGURE 5 – *Line 330 for 625-line systems*

d05-sc

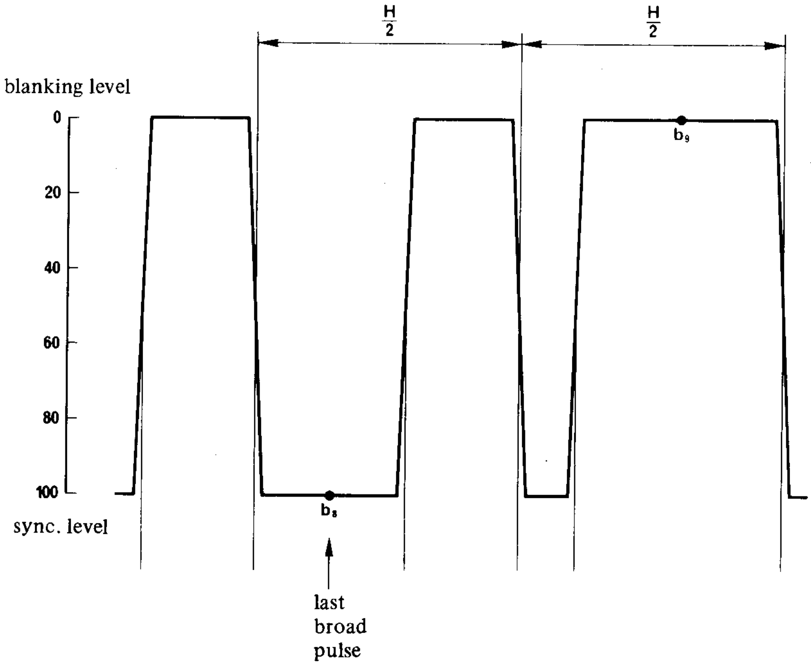

FIGURE 6 – *Measurement points for sync. amplitude error during equalizing pulse period*

d06-sc

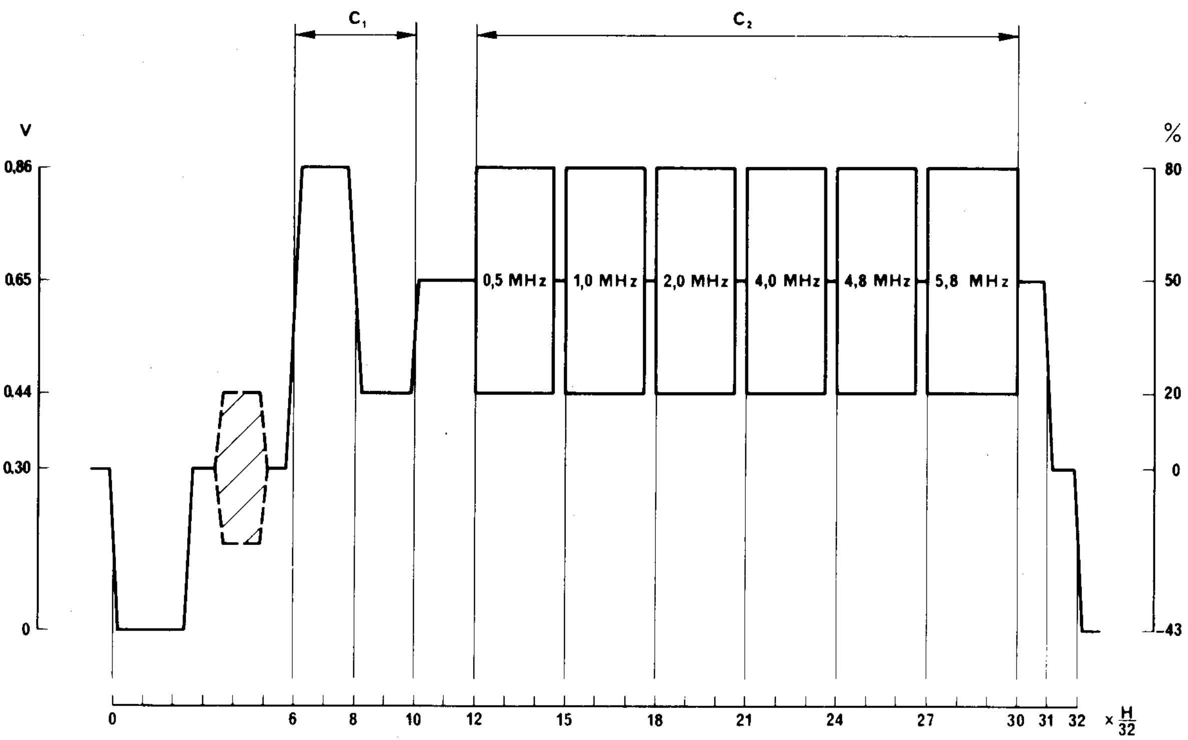

FIGURE 7 – *Line 18 for 625-line systems*

d07-sc

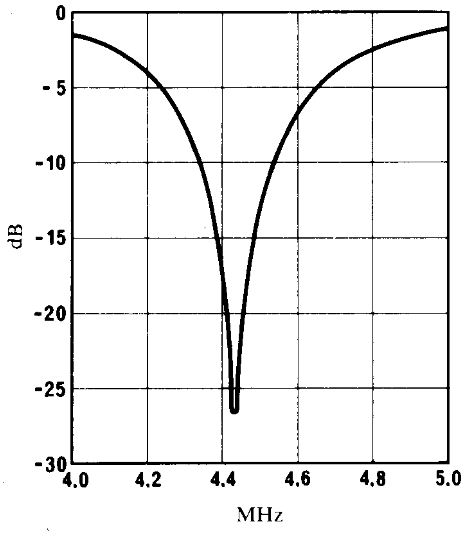

FIGURE 8 – *Response of sub-carrier notch filter for 625-line systems*

3 dB bandwidth: 600 kHz
Attenuation at 4.43 MHz ⩾26 dB
d08-sc

TABLE I – *Theoretical values of conversion factors in dB*
(rounded off to a tenth of dB)

		200 kHz high pass filter 20 dB/decade	Sub-carrier notch filter 3 dB bandwidth = 600 kHz
White noise	unweighted weighted	0.3 1.3	0.7 0.2
Triangular noise	unweighted weighted	0.0 0.0	1.8 1.3
De-emphasized triangular noise	unweighted weighted	0.0 0.0	1.6 0.9

REFERENCES

THOMSON, W. E. [1952] "Solution 3". *Proc. IEE*, Part III, **99**, 373.

CCIR Documents

[1974-78]: CMTT/78 (Italy).

[1978-82]: **a.** CMTT/270 (Germany (Federal Republic of)); **b.** CMTT/41 (France).

BIBLIOGRAPHY

CCIR Documents

[1978-82]: CMTT/304 (OIRT).