



INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

N.73

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

MAINTENANCE OF INTERNATIONAL SOUND – PROGRAMME AND TELEVISION TRANSMISSION CIRCUITS

MAINTENANCE OF PERMANENT INTERNATIONAL TELEVISION CIRCUITS, LINKS AND CONNECTIONS

ITU-T Recommendation N.73

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation N.73 was published in Fascicle IV.3 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 N.73

MAINTENANCE OF PERMANENT INTERNATIONAL TELEVISION CIRCUITS, LINKS AND CONNECTIONS

1 Introduction

In most cases, circuits used for television transmissions are provided by the Administrations, although in some countries broadcasting organizations own all or part of the circuits within national boundaries.

The routine maintenance of circuits used for transmissions between two or more countries requires the closest cooperation between the Administrations/broadcasting organizations that provide the circuit sections.

It is recommended that routine maintenance measurements be carried out each month on permanently installed terrestrial circuits.

This Recommendation applies also for routine test transmission over leased satellite circuits for television transmissions directed to TVROs not related to an ITC.

2 Test signal elements

Diagrams of the different test-signal elements as defined in CCIR Recommendation 567 [1] are given in Annex A; the titles of those test-signal elements with the reference designations are given below:

Field bar	Signal A	Figures A-1/N.73 and A-2/N.73
Sine-squared pulse	Signal B1	Figures A-3/N.73 and A-4/N.73
Luminance bar	Signal B2 or, B3	Figures A-3/N.73 and A-4/N.73
Multiburst	Signal C	Figures A-5/N.73 and A-6/N.73
Staircase	Signal D1 and D2	Figures A-7/N.73 and A-8/N.73
Composite pulse	Signal F	Figures A-9/N.73 and A-10/N.73
Chrominance bar	Signal G1 (625-lines only)	Figure A-11/N.73
Three level chrominance bar	Signal G2 (625-lines only)	Figure A-11/N.73
Three level chrominance bar	Signal G (525-lines only)	Figure A-12/N.73

3 Test equipment

3.1 Generators

CCIR Recommendation 473 [2] defines the insertion test signals required for measurement purposes. The assembly of test signal elements in test lines is also referred to in Recommendation N.67 and most modern test signal generators can originate the test signals, either as insertion test signals or as full-field test signals. In the latter mode measurements can be carried out at standard values of average picture level (APL).

The assembly of test signal elements in the test lines is sufficient for the measurement of the large majority of television circuit parameters, that is, distortions occurring at line frequency and above. However, additional test signals are needed for low and very low-frequency measurements. A field bar is required for the measurement of field time distortions and, for the measurement of long-time waveform distortion, a signal is required which is switched at intervals of a few seconds between low and high APLs. (For further details see CCIR Report 636 [3].)

3.2 Measurement equipment

The measurement equipment may consist of:

- an oscilloscope or television waveform monitor with additional equipment for making nonlinearity measurements¹⁾;

¹⁾ A line selector for selecting insertion test lines for display with older type waveform monitors or oscilloscopes is commercially available.

- modern television waveform monitors equipped with line-selection and means for measuring nonlinearity distortion;
- automatic measurement equipment.

4 Measurement definitions

CCIR Recommendations 567 [1] and 569 [4] define the measurements that may be made on television circuits. There are slight differences in the way certain similar parameters are defined, for example, insertion gain and luminance bar amplitude, and differences in the way the results are expressed, for example, luminance bar amplitude and luminance bar amplitude error. To standardize routine maintenance measurements, it is recommended that the definitions given in Recommendation 569 [4] be used for maintenance purposes whenever possible. The results are then easier to analyze because the result of a measurement is zero for an undistorted parameter.

5 Access points

Measurements are taken at television signal access points which are well-defined points associated with the input and output of a television circuit. To suit the characteristics of the measurement equipment, the standard level/impedance at the access point should be 1 volt peak-to-peak into 75 ohms. The return loss at the access point shall be better than 30 dB.

The access point may be the point of interconnection or may be connected to it by a distortion-free circuit having zero loss or gain.

For flexibility, and to ensure that measured parameters are comparable to transmission parameters, it is necessary that the interconnection system in the ITC should handle programme and test signals in the same way. Figure 1/N.73 shows one method of realizing that objective.

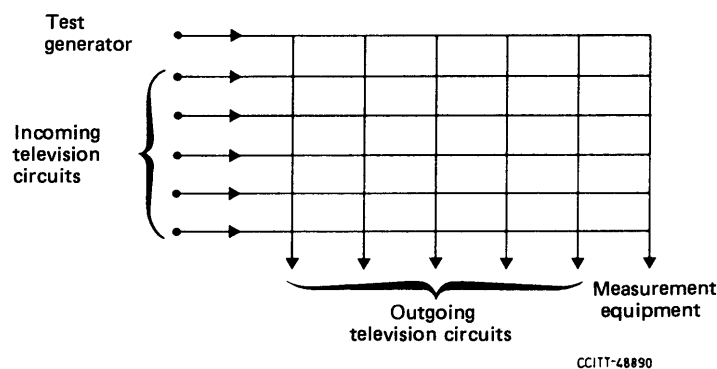


FIGURE 1/N.73

d01-sc

A typical television circuit/test signal
switching matrix

6 Routine verification of test equipment

To ensure that test equipment errors will not lead to incorrect adjustment of a television circuit, the test equipment should be verified regularly.

The connection between the test signal generator and the measurement equipment, via the interconnection system, should be verified at intervals of, say, three months and the results should be within the limits given in Table 1/N.73.

TABLE 1/N.73

Limits for measurement chains

Parameter	Limits
Luminance bar amplitude error	$\pm 1\%$
Bar tilt/Base line distortion	$\pm 1\%$
2T pulse/bar ratio error	$\pm 2\%$
Peak differential gain	$\pm 1\%$
Peak differential phase	$\pm 1^\circ$
Chrominance/luminance gain inequality	$\pm 2\%$
Chrominance/luminance delay inequality	$\pm 5 \text{ ns}$
Signal-to-continuous-noise ratio (unified weighted)	$\geq 65 \text{ dB}$

7 Maintenance limits

The figures given in Table 2/N.73 showing the maintenance limits are based on the design objectives for hypothetical reference circuits given in CCIR Recommendation 567 [1] but refer to international television circuits, nominally one-third of the length of the hypothetical reference circuit, between terminal ITCs which are normally in adjacent countries. These limits are expected to apply for most of the time but may be exceeded for part of the time. Hence, maintenance staff must exercise judgement on the action to be taken when a circuit is outside the maintenance limits for any parameter. If the results are well outside the limits, for example, if the error is greater than twice the limit value or the signal-to-noise ratio is 3 dB worse than the limit value, the fault should be located and corrected. On the other hand, if the limits are only exceeded by a relatively small amount, corrective action should not be carried out unless a given parameter exceeds the maintenance limits in two successive months.

Maintenance limits for circuit sections which are different in length and construction from the circuit section equal to one third of the hypothetical reference circuit may be derived by the application of the Laws of Addition specified in CCIR Recommendation 567 [1] to the limits quoted in Table 2/N.73, but the precautions in § 10 should be noted.

TABLE 2/N.73

Maintenance limits for permanent international television circuits

Item (Note 12)	Parameter	Test waveforms(s)	Maintenance limits	
			525	625
1	Luminance bar-error (Note 1)	B2 or B3	± 11 IRE units	$\pm 11\%$ (± 1 dB)
2	Variation of luminance bar-error (e.g. 1 s)	B2 or B3	± 3 IRE units	$\pm 2\%$ ($\pm 0,2$ dB)
3	Variation of luminance bar-error (e.g. 1 hour)	B2 or B3	± 8 IRE units	$\pm 11\%$ (± 1 dB)
4	Signal-to-continuous-weighted-noise ratio	No input signal (Notes 1, 3) or “quiet” line (Notes 2, 4)	≥ 56 dB	≥ 52 dB (Note 10)
5	Signal-to-periodic-noise ratio (power supply frequency $\sim 0,1$ kHz) (Note 2)	No input signal	≥ 35 dB (Note 5)	
6	Signal-to-periodic-noise ratio ($1\text{ kHz} - f_c$) (Note 2)	No input signal	≥ 55 dB	
7	Signal to impulsive noise ratio (Note 2)	No input signal	≥ 25 dB	
8	Luminance-non-linearity (Note 1)	D1	3%	10%
			(Note 6)	
9	Chrominance gain non-linearity (Note 2)	G or G2	4%	7%
			(Note 6)	
10	Chrominance phase non-linearity (Note 2)	G or G2	4	5
			(Note 6)	
11	Peak differential gain (Note 1)	D2	$\pm 10\%$	$\pm 8\%$
			(Note 6)	
12	Peak differential phase (Note 1)	D2	± 3	± 5
			(Note 6)	
13	Chrominance-luminance intermodulation (Notes 1, 2)	G or G2	$\pm 3\%$ (Note 6)	
14	Sync. amplitude error (Note 1)	(Note 7)	$\pm 10\%$ (Note 6)	
15	Long-time waveform distortion (Note 2)	“Bump” signal	40% (Notes 13, 14)	

TABLE 2/N.73 (cont.)

Item (Note 12)	Parameter	Test waveform(s)	Maintenance limits	
16	Field-time waveform distortion (Note 2)	A (Note 11)	$\pm 2\%$	$\pm 6\%$
17	Line-time waveform distortion (Note 2) Bar tilt (Note 1)	B2 or B3	$\pm 1\%$	$\pm 3\%$
18	Base line distortion (Note 1)	B2 or B3	$\pm 1\%$	$\pm 3\%$
19	2T pulse/bar ratio error (Note 1)	B1 and B2 or B3	$\pm 6\%$	$\pm 8\%$
20	Short-time waveform distortion (Note 2)	B1	1 st adjacent lobe 6% 2 nd adjacent lobe 3%	
21	Gain/frequency characteristic (Note 2)	C (Note 8)	± 1 dB	+ 1,5 dB to -1 dB
22	Chrominance-luminance gain inequality (Note 1)	B2 or B3 and G, G2 or F	$\pm 10\%$	$\pm 10\%$
23	Chrominance-luminance delay inequality (Note 1)	F	± 80 ns (Note 9)	

Note 1 – As defined in CCIR Recommendation 569 [4].

Note 2 – As defined in CCIR Recommendation 567 [1].

Note 3 – Noise measured via unified weighting filter and low and high pass filters specified in Annex II to Part C of CCIR Recommendation 567 [1].

Note 4 – Noise measured on line(s) allocated for noise measurement with weighting network and filters as given in Note 3 plus a chrominance frequency notch filter as specified in CCIR Recommendation 569 [4].

Note 5 – The maintenance limits refer to circuits without clamps. When clamps are used the maintenance limits are ≥ 50 dB.

Note 6 – Measured at APLs of 10% and 90%.

Note 7 – Video signal containing synchronizing signals with normal amplitude.

Note 8 – Measurements on C2 may be referred to C1 taking account of any difference in the amplitude of the two elements. The results of this test may conflict with those obtained with test waveforms. If this occurs the waveform results should be considered to be definitive.

Note 9 – The value is positive if the luminance component leads the chrominance component.

Note 10 – Further data is required to consider amendment to this figure.

Note 11 – A window signal is specified in CCIR Recommendation 567 [1] for use on 525-line systems. Test results are required before limits for this signal can be included. Use of this signal should be noted in the measurement results.

Note 12 – Routine measurements made at regular intervals may be limited to less than the complete list of items given in Table 2/N.73 by agreement between the Administrations concerned.

Note 13 – The value is provisional and for further study.

Note 14 – The maintenance limit applies to testing a circuit without clamping. This is the preferred method of measurement. When clamps are used, the maintenance limit is 6%.

8 Schedule for routine maintenance measurements

The performance of routine maintenance measurements between two ITCs requires adherence to routine procedures and a due regard to the allocated time. Tests (Table 3/N.73) should start at a scheduled time (Z) which has been agreed between the Administrations/broadcasting organizations concerned and should progress in accordance with the fixed timetable. This will give adequate time for measurements to be repeated if there is a possibility that one or more circuit parameters are outside tolerance limits.

It is necessary for the maintenance staff to book the routine maintenance period with the programme booking centre (PBC) on a regular basis so that the PBC can intervene when bookings are made for programme transmissions at the same time, and propose a different period for the routine maintenance measurements.

The test schedule shown in Table 3/N.73 should be used by the sub-control station at the sending end of the circuit unless there is a specific agreement between the Administrations/broadcasting organizations concerned to use a different test schedule.

TABLE 3/N.73

Schedule for routine maintenance measurements

Duration	Operation	Signal
Z to $Z + 5$ min	Check level	B2 or B3
$Z + 5$ to $Z + 10$ min	Measurement of linear distortions (APL low)	Test lines
$Z + 10$ to $Z + 15$ min	Measurement of nonlinear distortions (APL low)	Test lines
$Z + 15$ to $Z + 20$ min	Measurement of nonlinear distortions (APL high)	Test lines
$Z + 20$ to $Z + 25$ min	Measurement of noise	None
$Z + 25$ to $Z + 30$ min	Measurement of field-time waveform distortion	A
$Z + 30$ to $Z + 35$ min	Measurement of long-time waveform distortion	“Bump”
$Z + 35$ to $Z + 95$ min	Variation of luminance bar amplitude	B2 or B3

Note – Z is the agreed time to commence the tests.

9 Maintenance of international television circuits

In general the programme booking centre (PBC) will not know when permanent connections are in use for programme transmissions and the agreement of the customer must be obtained before such connections are interrupted in ITCs to carry out maintenance on a circuit.

10 Maintenance of international television circuits, links and connections

International television circuits, links and connections will comprise chains of circuit sections, both national and international, connected in tandem, which are maintained and may be leased as separate entities. Each of these circuit sections may have suitable maintenance limits derived as quoted in § 7.

The Laws of Addition may also be used to derive expected performance limits for such chains but precautions are necessary in the use of such limits for maintenance purposes. It is possible that the overall response of the circuit, link or connection may fail to meet the calculated performance expected, even though the response of each circuit section comprising the chain meets the individual maintenance limits used for the calculation of the overall response. In such cases the calculated response of the chain can only be used as a guide to the expected overall response on the initial lining up, unless additional overall equalizers are employed.

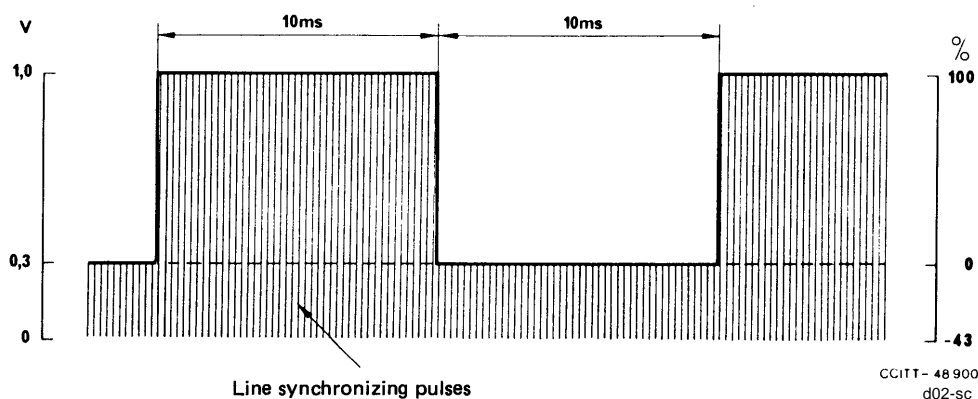
There is also the possibility that the difference between the actual and the calculated overall response of the chain can vary with time, even though the responses of the individual circuit sections remain within their respective maintenance limits.

ANNEX A

(to Recommendation N.73)

Test signal elements

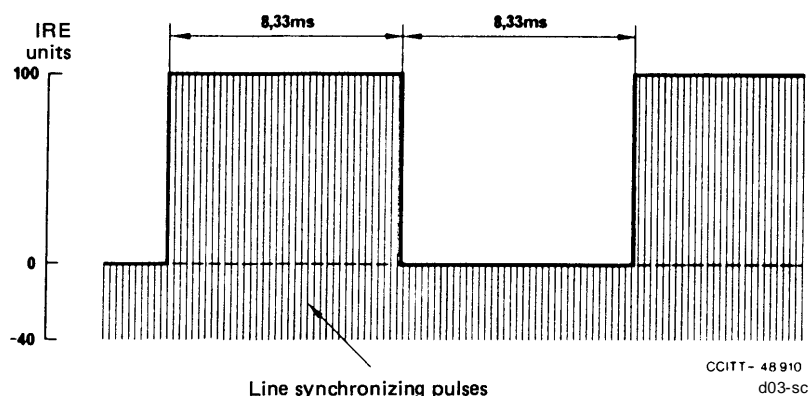
An indication of the signal elements required to carry out the tests mentioned in this Recommendation is given below in the form of figures. Preferred assemblies for insertion test signals are given in Recommendation N.67.



Note – This signal may contain field-synchronizing pulses.

FIGURE A-1/N.73

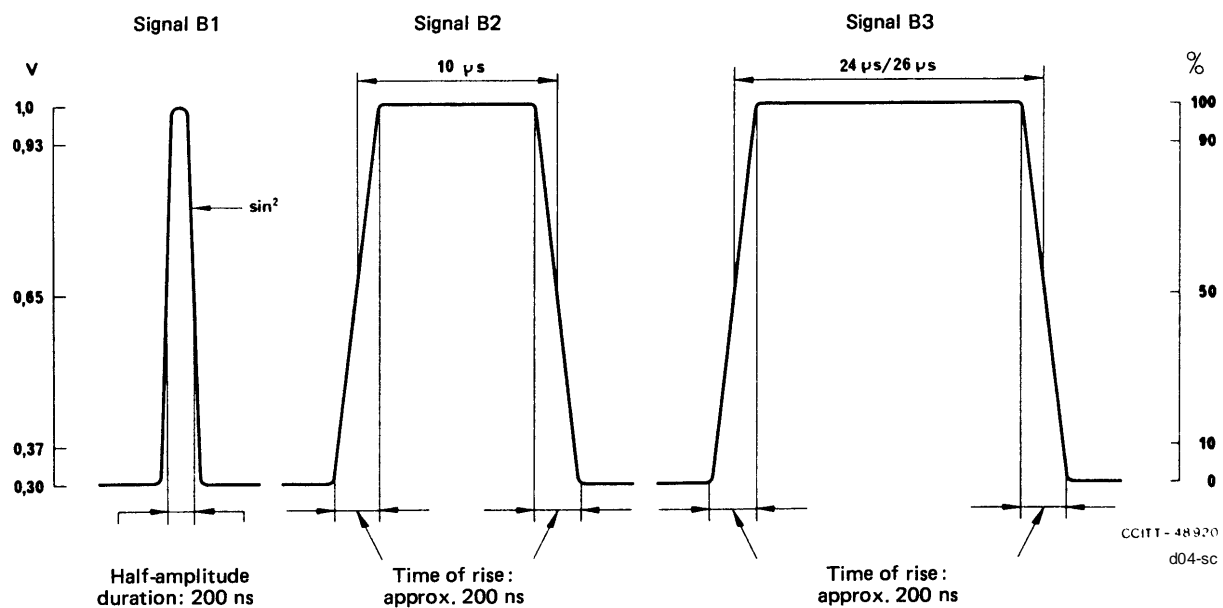
Signal A for 625-line circuits



Note – This signal may contain field-synchronizing pulses.

FIGURE A-2/N.73

Signal A for 525-line circuits



Note 1 – In some OIRT countries, a half-amplitude duration of 160 ns is used for B1 and a time of rise of 80 ns for B2.

Note 2 – In France, the normal time of rise of B2 and B3 is approximately 110 ns.

FIGURE A-3/N.73

Signal B for 625-line circuits

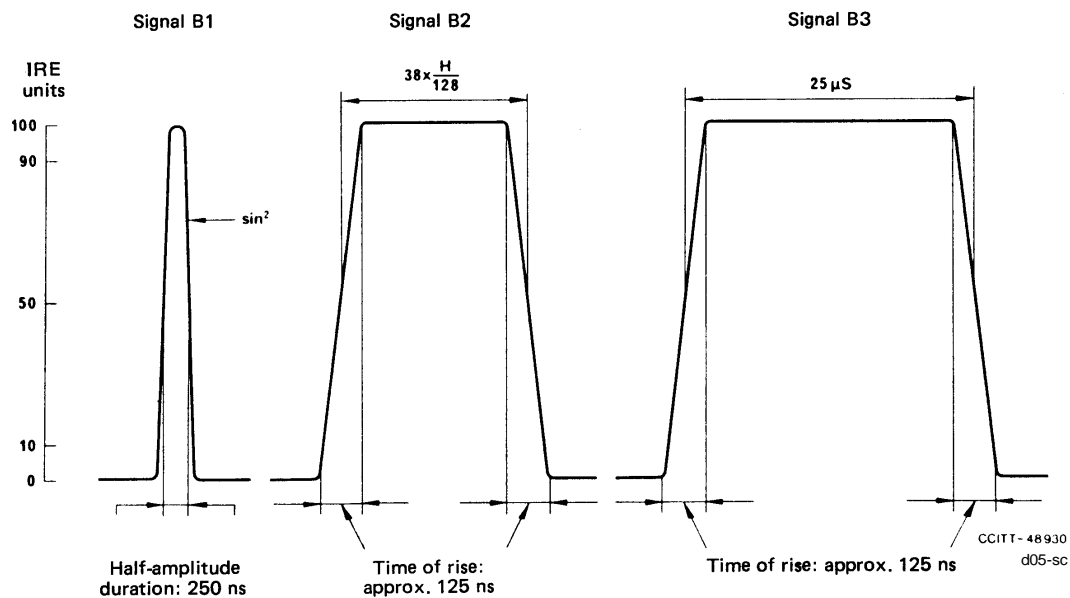
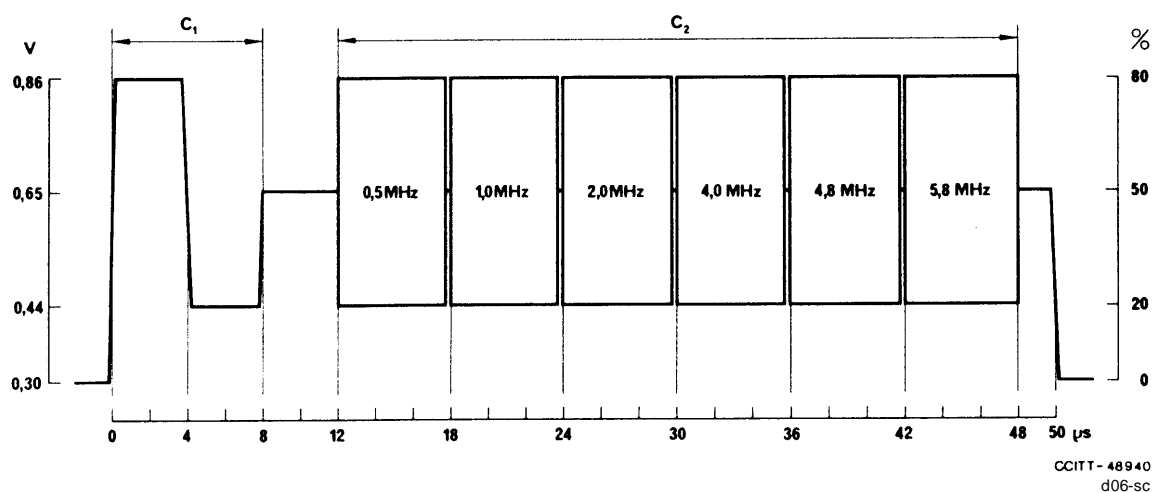


FIGURE A-4/N.73

Signal B for 525-line circuits



Note – Some OIRT countries use 1.5 MHz and 2.8 MHz for the 2nd and 3rd bursts.

FIGURE A-5/N.73
Signal C for 625-line circuits

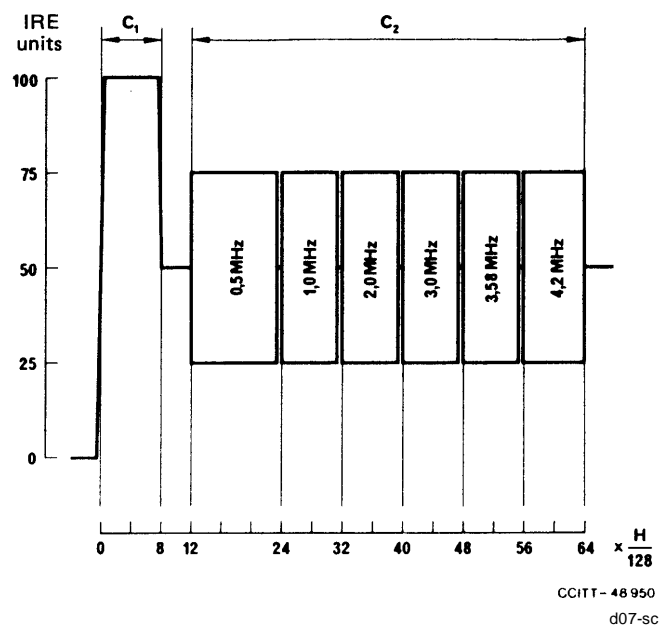
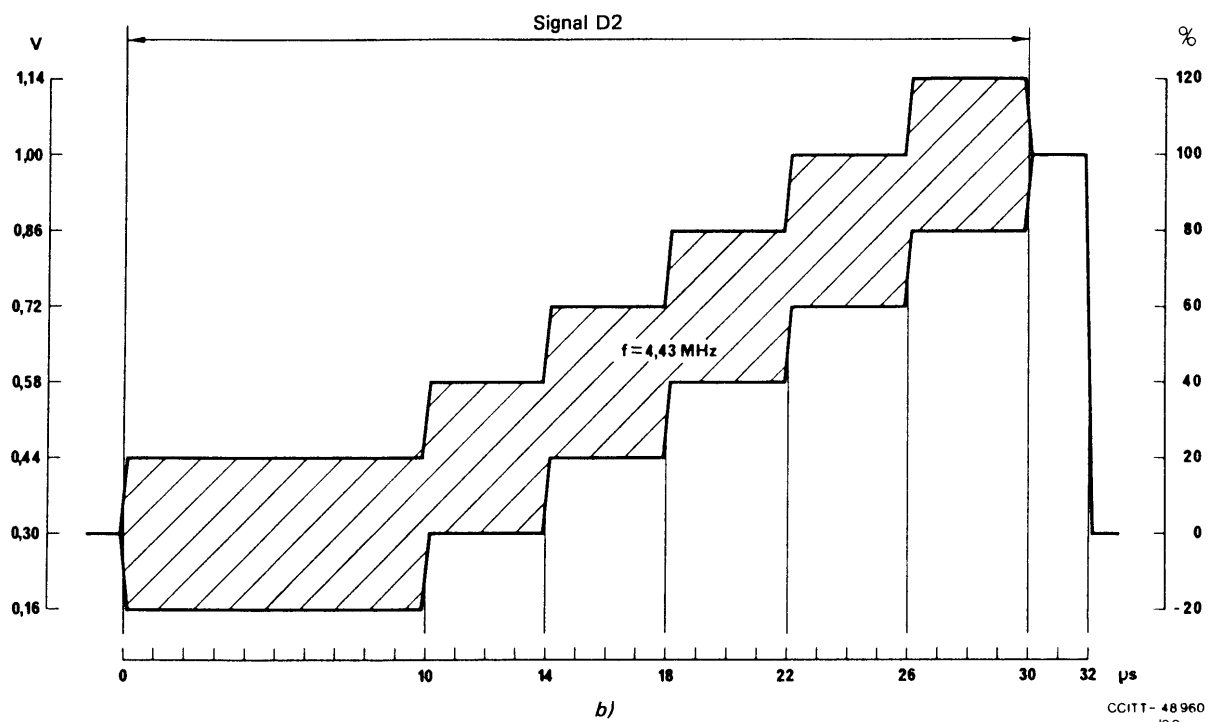
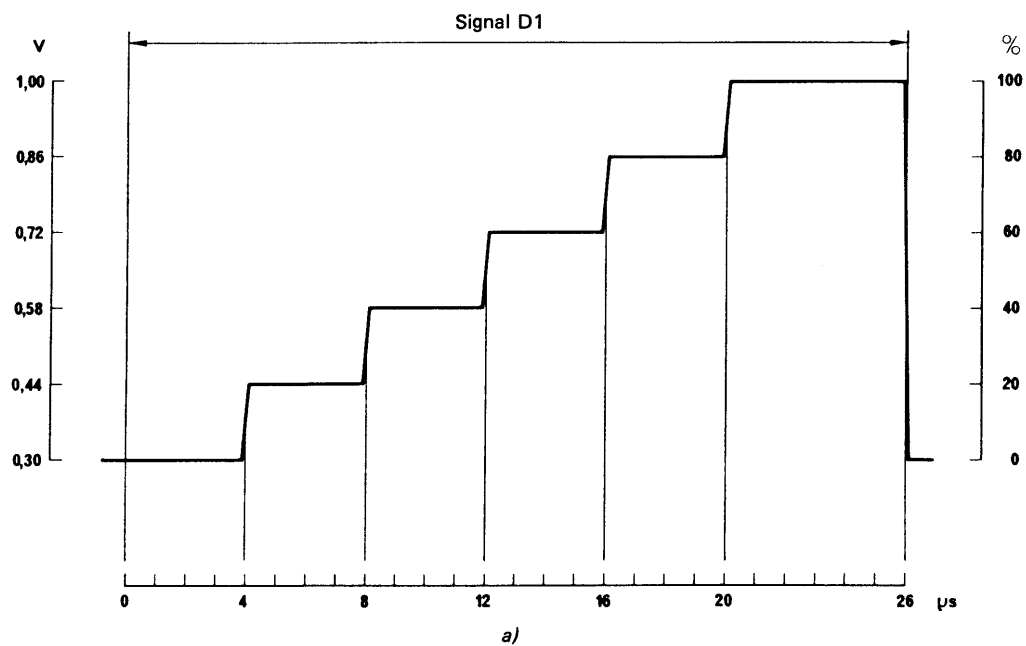
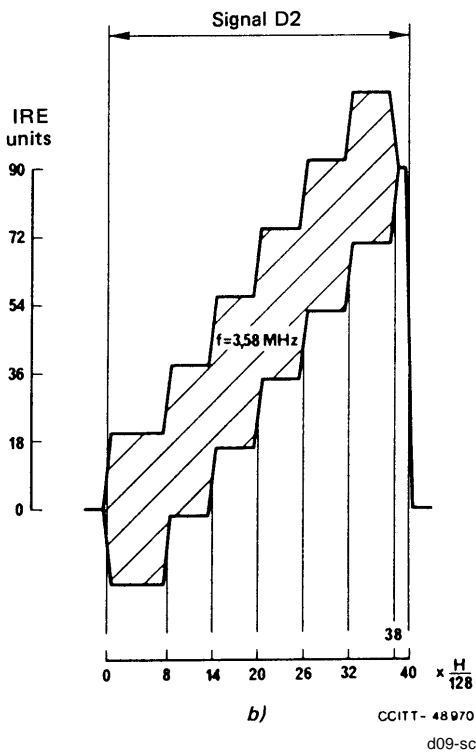
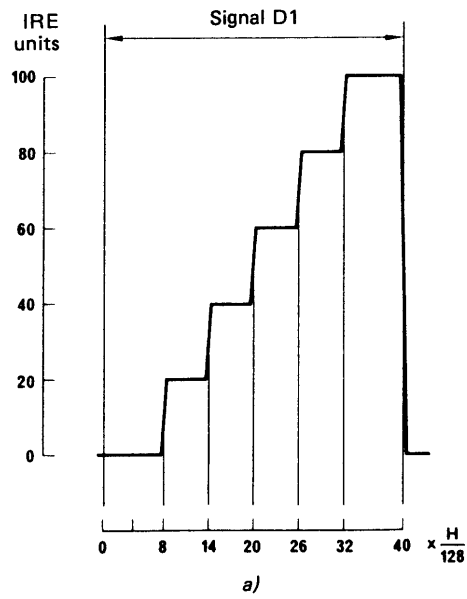


FIGURE A-6/N.73
Signal C for 525-line circuits



Note – In full-field test signals, each tread of the staircase may have a duration of 8.66 μs.

FIGURE A-7/N.73
Signal D for 625-line circuits



Note 1 – Scale refers to tread levels.

Note 2 – Sub-carrier amplitude is ± 20 IRE units.

FIGURE A-8/N.73

Signal D for 525-line circuits

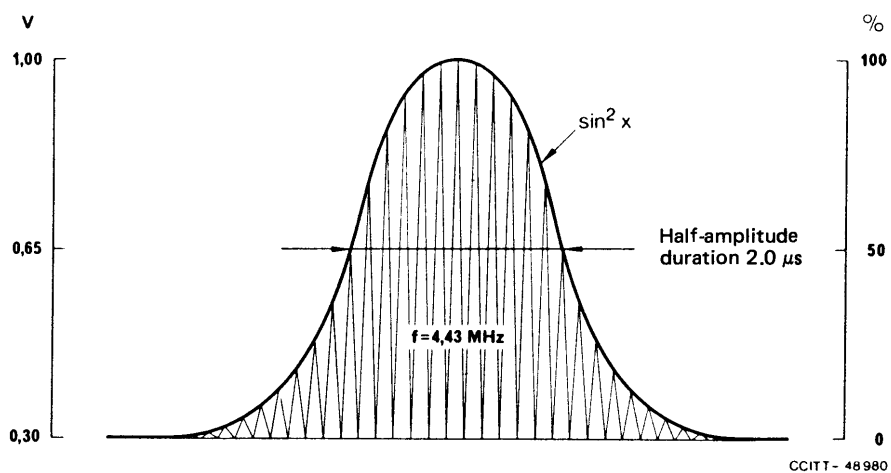


FIGURE A-9/N.73
Signal F for 625-line circuits

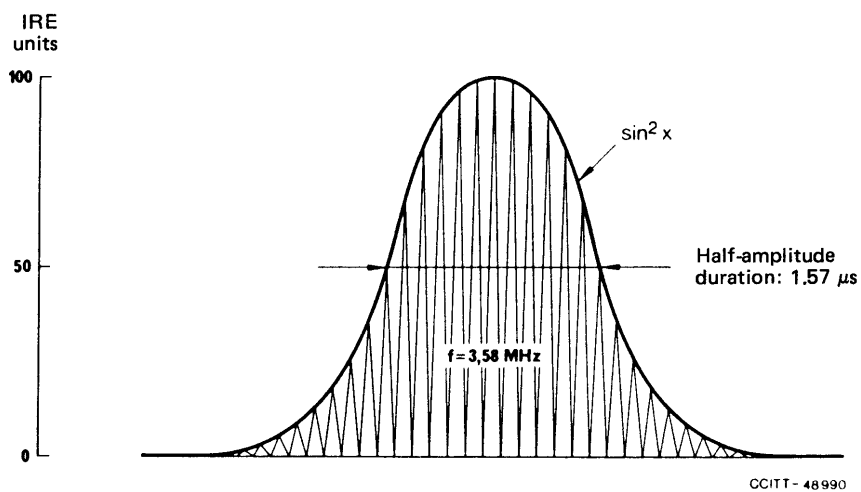


FIGURE A-10/N.73
Signal F for 525-line circuits

d10-sc

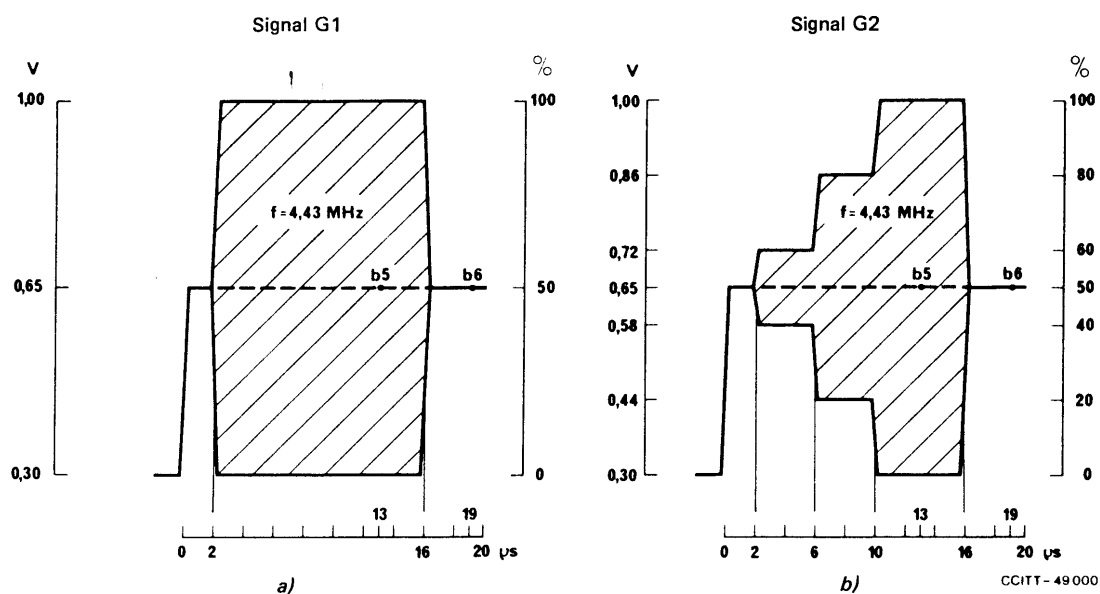


FIGURE A-11/N.73
Signal G for 625-line circuits

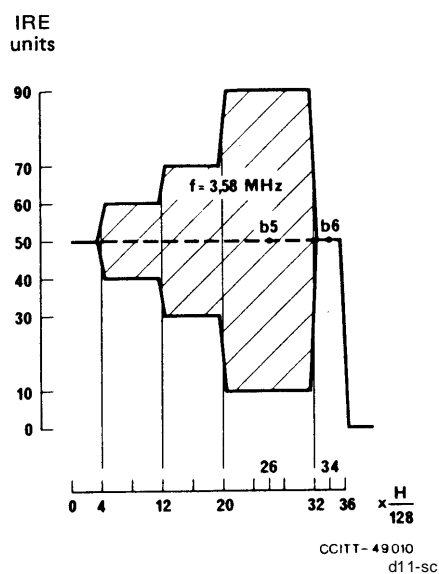


FIGURE A-12/N.73
Signal G for 525-line circuits

References

- [1] CCIR Recommendation *Television performance of television circuits designed for use in international connections*, Vol. XII, Rec. 567, ITU, Geneva, 1986.
- [2] CCIR Recommendation *Insertion of test signals in the field blanking interval of monochrome and colour television signals*, Vol. XII, Rec. 473, ITU, Geneva, 1986.
- [3] CCIR Report *Long-time waveform distortion in long distance television circuits*, Vol. XII, Rec. 636, ITU, Geneva, 1986.
- [4] CCIR Recommendation *Definitions of parameters simplified for automatic measurement of television insertion test signals*, Vol. XII, Rec. 569, ITU, Geneva, 1986.