

**IEEE Trial-Use Standard on
Video Signal Transmission
Measurement of Linear Waveform Distortion**

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**Audio-Video Techniques Committee of the
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Comments on this Trial-use Standard are welcomed and should be addressed to:
Secretary, IEEE Standards Board, 345 East 47th Street, New York, N.Y. 10017.

After a trial-use period of approximately one year, the Group responsible for this document will prepare a revision and submit it to the Standards Board for approval as a full-status standard.

Foreword

(This foreword is not part of IEEE Std 511-1974, Standard on Video Signal Transmission Measurement of Linear Waveform Distortion.)

This standard is the first document issued since the merger of IEEE Audio-Video Techniques Committee and the IEEE Professional Group on Broadcasting G.2.

Subcommittee 2.1.4. Video Signal Transmission of the IEEE Group on Broadcasting has been meeting since 1967. The membership was then as follows:

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A task force was originated to formulate a standard on measurement of Linear Waveform Distortion. During the past six years, this task force has prepared numerous drafts of the standard and although substantial gaps have been closed between various conflicting viewpoints, by early 1973 full agreement had not been reached. At that time the chairman of the Subcommittee and the task force Chairman decided to submit the standard to the parent committee with the recommendation that it be issued as a Trial-Use Standard.

After incorporating some of their comments, the Audio-Video Techniques Committee voted on May 1, 1973 to approve the proposed Standard on Trial-Use basis. The document was then reviewed, modified, and approved for trial use by the IEEE Standards Board. The Video Signal Transmission Subcommittee had the following membership in 1973.

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IEEE Trial-Use Standard on Video Signal Transmission Measurement of Linear Waveform Distortion

1. Introduction

1.1 Scope. This standard describes methods for measuring the linear waveform distortions of TV video signals, that is, distortions which are caused by amplitude-independent (linear) transmission characteristics of television equipment and facilities.¹

The primary application of this standard is for routine operational and maintenance tests, where rapid interpretation of test results is desirable. The techniques described here may also be applicable to laboratory measurements, proof-of-performance measurements, and detailed maintenance procedures.

1.2 Definitions and Explanations. For tutorial purposes the definitions are presented in a logical sequence so that terms defined in the beginning of the section can be used in definitions toward the end of the section.

1.2.1 General Terms.

linear distortion. That distortion of an electrical signal which is independent of the signal amplitude.

NOTE: A small-signal nonuniform frequency response is an example of linear distortion. By contrast, nonlinear distortions of an electrical signal are those distortions that are dependent on the signal amplitude, for example, compression, expansion, and harmonic distortion, etc.

TV waveform signal. An electrical signal whose amplitude varies with time in a generally non-sinusoidal manner, whose shape (that is, duration and amplitude) carries the TV signal information.

linear TV waveform distortion. The distortion of the shape of a waveform signal where this

distortion is independent of the amplitude of the signal.

NOTES: (1) A TV video signal may contain time components with durations from as long as a TV field to as short as a picture element. The shapes of all these time components are subject to distortions. For ease of measurement it is convenient to group these distortions in three separate time domains; short-time waveform distortion, line-time waveform distortion, and field-time waveform distortion.

(2) The waveform distortions for times from one field to tens of seconds is not within the scope of this standard.

short-time waveform distortion (SD). The linear TV waveform distortion of time components from 125 ns to 1 μ s, that is, time components of the short-time domain.

line-time waveform distortion (LD). The linear TV waveform distortion of time components from 1 μ s to 64 μ s, that is, time components of the line-time domain.

field-time waveform distortion (FD). The linear TV waveform distortion of time components from 64 μ s to 16 ms, that is, time components of the field-time domain.

$\sin^2$ pulse. One cycle of a sine wave, starting and finishing at its negative peaks with an added constant amplitude component of half the peak-to-peak value, thus raising the negative peaks to zero.

NOTE: As shown in detail in Appendix A, a $\sin^2$ pulse is obtained by squaring a half-cycle of a sine wave.

$\sin^2$ step. A step function whose transition from zero to the final value is the sum of a ramp and a negative sinusoid of equal durations, with zero slope at both the zero and the final value of the step.

NOTES: (1) As shown in detail in Appendix A, a $\sin^2$ step is obtained by integrating a $\sin^2$ pulse.

(2) The attractiveness of both the $\sin^2$ pulse and the $\sin^2$ step lies in the fact that their frequency spectra are limited; that is, they are effectively at zero ampli-

¹This standard applies specifically to equipment and facilities operating as a CCIR System M (525 lines/60 fields, monochrome or NTSC color).

tude beyond a given frequency. For the $\sin^2$ pulse this frequency is a function of the half-amplitude duration (HAD) of the pulse; for the $\sin^2$ step the frequency is a function of the 10 percent to 90 percent rise time.

T. Letter symbol for the duration of a half-period of the nominal upper cut-off frequency of a transmission system. Therefore

$$T = \frac{1}{2 f_c}$$

NOTE: For the TV system M

$$T = \frac{1}{2 \times 4 \text{ (MHz)}} = 125 \text{ (ns)}$$

The duration T is commonly referred to as the Nyquist interval. The concept of T is employed not only when the frequency cut-off is a physical property of a given system but also when the system is flat and there is no interest in the performance of the system beyond a given frequency.

1.2.2 Terms for Waveform Test Signals in TV System M.

T pulse. A $\sin^2$ pulse with a half-amplitude duration (HAD) of 125 ns. The amplitude of the envelope of the frequency spectrum at 4 MHz is 0.5 of the amplitude at zero frequency and effectively zero at and beyond 8 MHz (see Figs 1 and 2).

2T pulse. A $\sin^2$ pulse with a half-amplitude duration (HAD) of 250 ns. The amplitude of the envelope of the frequency spectrum at 2 MHz is 0.5 of the amplitude at zero frequency and effectively zero at and beyond 4 MHz (see Figs 1 and 2).

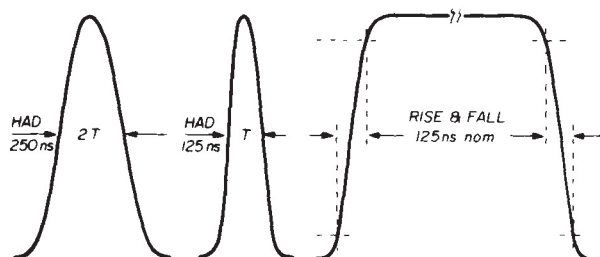


Fig 1
2T Pulse, T Pulse, and T Step

NOTE: The $2T$ pulse is mentioned here for the sake of completeness. The short-time domain may be tested by the $2T$ pulse in conjunction with the T pulse and a reference signal. This method is not used in this standard since the T step alone tests the short-time domain in a simpler and more direct manner.

T step. A $\sin^2$ step with a 10 percent–90 percent rise (fall) time of nominally 125 ns. The amplitude of the envelope of the frequency spectrum is effectively zero at and beyond 8 MHz (see Figs 1 and 2).

NOTE: In practice the T step is part of a square wave, (or line bar as described below) so that there is a T step rise and fall.

modulated 12.5T pulse (MOD 12.5T). A burst of color subcarrier frequency of nominally 3.58 MHz. The envelope of the burst is $\sin^2$ shaped with a half-amplitude duration (HAD) of nominally 1.56 μ s. The MOD 12.5T pulse consists of a luminance and a chrominance component. The envelope of the frequency spectrum consists of two parts, namely signal energy concentrated in the luminance region below 0.6 MHz and in the chrominance region from roughly 3 MHz to 4.2 MHz. (see Figs 3 and 4).

line bar. A pulse, nominally of 20 μ s duration, of reference-white amplitude (see Fig 5). The rise and fall portions of the line bar are T steps as defined.

field bar. A composite pulse, nominally of 8 ms duration, of reference-white amplitude. The field bar is composed of line bars as defined.

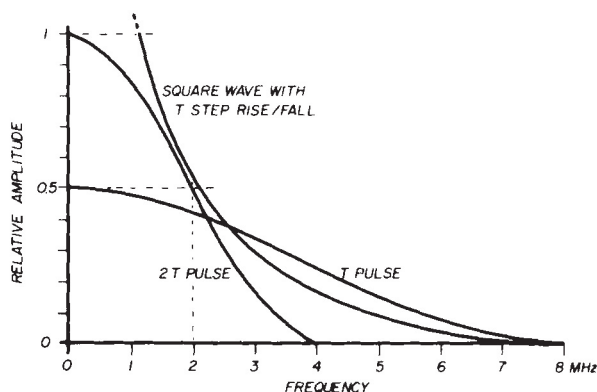


Fig 2
Envelope of Frequency Spectrum of
2T Pulse, T Pulse and Square Wave
with T Step Rise and Fall