REPORT 1218

MEASUREMENTS IN HDTV*

(Question 27/11, Study Programme 27C/11)

(1990)

1. Introduction

High-definition television (HDTV) is currently under development. Measurement of HDTV parameters represents a new task, and such measurement techniques should be defined in advance of the development and implementation of the associated hardware.

2. General considerations

In generating HDTV signals, the luminance components require a bandwidth of approximately 30 MHz (for progressive scanning the bandwidth is approximately 60 MHz) and the colour-difference signals occupy a bandwidth of the order of 15 MHz each (30 MHz for progressive scanning).

[CCIR, 1986-90a] states that the requirements for accuracy in the generation and transmission of HDTV signals (before and after coding) increase significantly since their distortion is more noticeable on large screens. The specific features of HDTV measurements are primarily conditioned by the wideband nature of the signals used [Krivocheev and Dvorkovitch, 1989].

[CCIR, 1986-90a] further states that HDTV signal distortions may also be due to inadequate transient response and the static and dynamic non-linearity characteristics of the HDTV signal encoding and transmission equipment, as well as different types of additive and multiplicative interference. Given the broad band of frequencies and the need for accurate control of signal level, digital processing techniques are required to allow adequate assessment of the signal. A mathematical treatment of the situation is provided in [CCIR, 1986-90a,b].

3. Testing methods

[CCIR, 1986-90a] suggests that the following transfer characteristics must be examined:

- very long-time distortions due to scene changes (at frequencies below the frame or field frequency);
- long-time distortions (at frame or field frequencies and their harmonics);
- line-time distortions (at the line frequency and its harmonics);

* See Recommendation 567 concerning test signals for conventional television systems.

- short-time distortions (at low to medium video frequencies);

- very short-time distortions of fine details (at the upper video frequencies).

The requirements for a series of test patterns and test signals adequate to accomplish the above have been studied and described in [Krivocheev, 1976; Dvorkovitch, 1988a and b; Krivocheev and Dvorkovitch, 1989; CCIR, 1986-90a].

Test signals have also been proposed in [CCIR, 1986-90b]:

- a multiburst sequence with two references for use in measuring the amplitude-frequency response* (Fig. 1);

- a complex signal sequence used to measure the transfer functions and the pulse characteristics of the luminance channel and the colour-difference channels* (Fig. 2);

- a sweep frequency waveform used to measure the continuous amplitude-frequency response and group delay (Fig. 3);

- a pair of step signals carrying pulsed signals of different polarities and sine test tones of different video frequencies, respectively, for evaluating static and dynamic non-linear distortions (Fig. 4).

[CCIR, 1986-90c] suggests elements of possible test patterns for high definition television and proposes examples of test patterns (Figs. 5 and 6):

- an HDTV test pattern consisting of black and white parallel lines of varying resolution and at different angles to the horizontal and vertical axes. This may be used for resolution estimation;

- an HDTV test pattern consisting of a circle of a specified diameter on a field of dots and orthogonal lines. This may be used in determining fixed pattern noise and raster distortions.

Study Programme 27C/11 also covers measurements on performance of transmission channels, and its effect may depend on the signal format used in the transmission.

For the MUSE transmission [CCIR, 1986-90d] reports that the resultant picture quality can well be described with measured values of amplitude errors at the sampling points by using a logistic function.

An HDTV C/N ratio checker and an HDTV digital audio bit-error counter, for use with satellite broadcasting of MUSE signal, have also been developed [CCIR, 1986-90e].

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* The groups of elements contained in this signal could be arranged either alternatively in the interval of one line of the signal or sequentially in several lines of the signal.

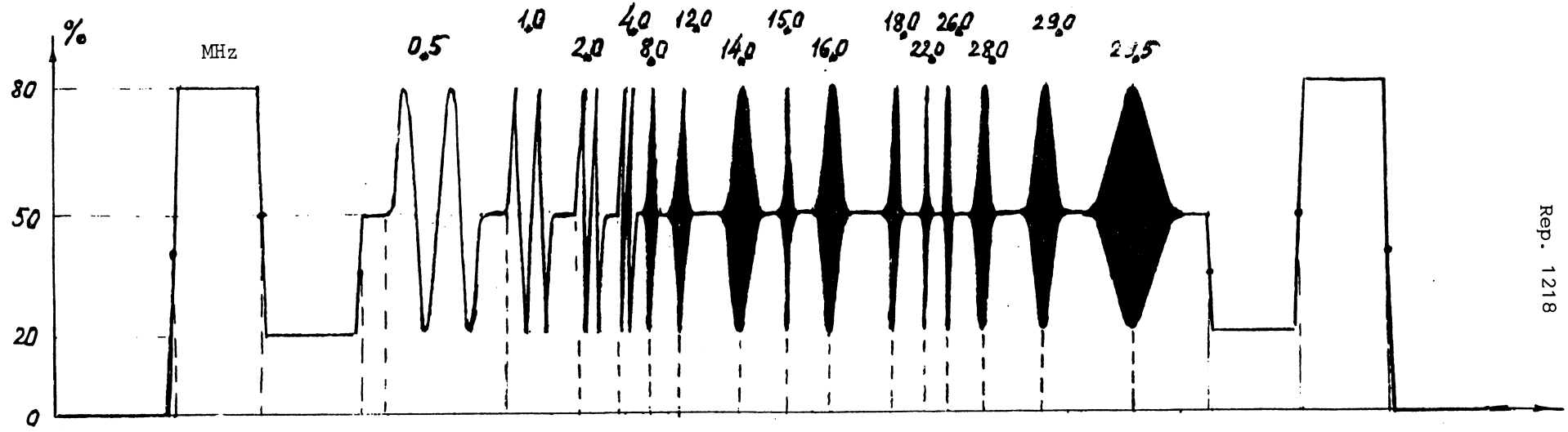

FIGURE 1

Test signal for measuring the amplitude-frequency response at a number of frequencies

Note: T = 16.67 ns

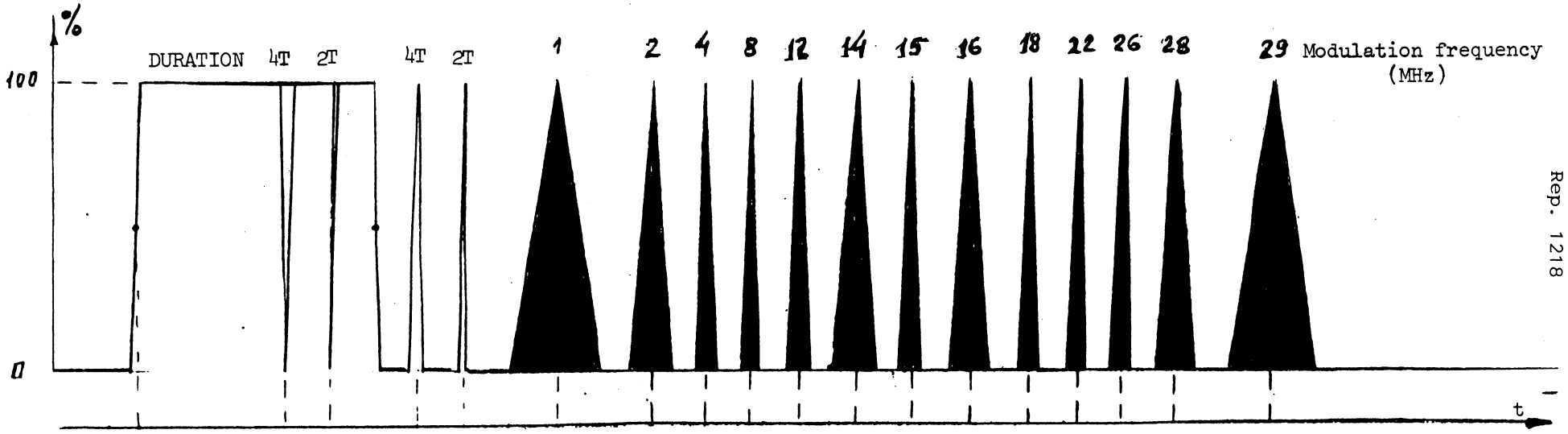

FIGURE 2

Test signal for the measurement of transfer functions and pulse characteristics

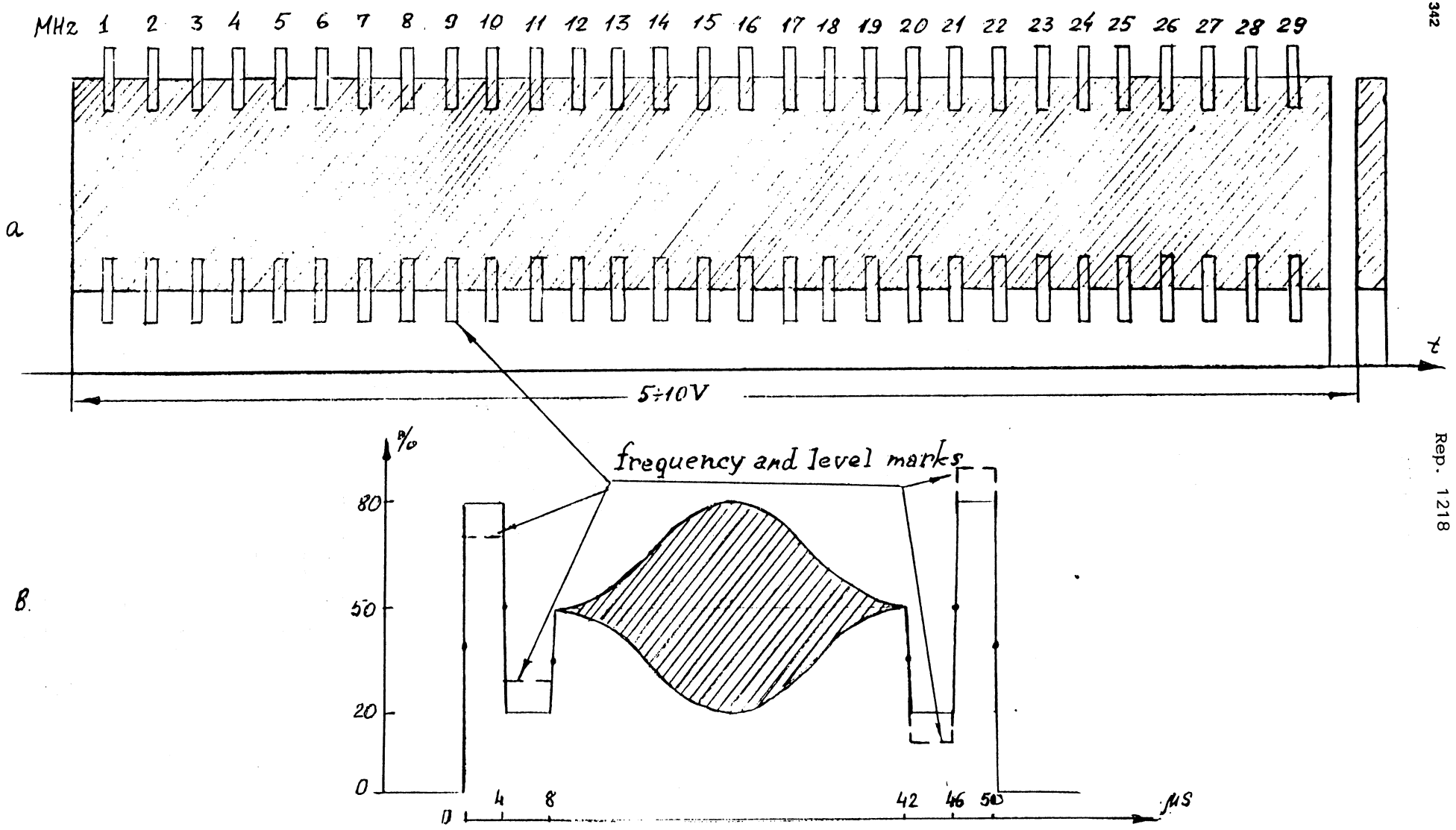

FIGURE 3 - Test signal for the measurement of continuous amplitude-frequency response and group delay

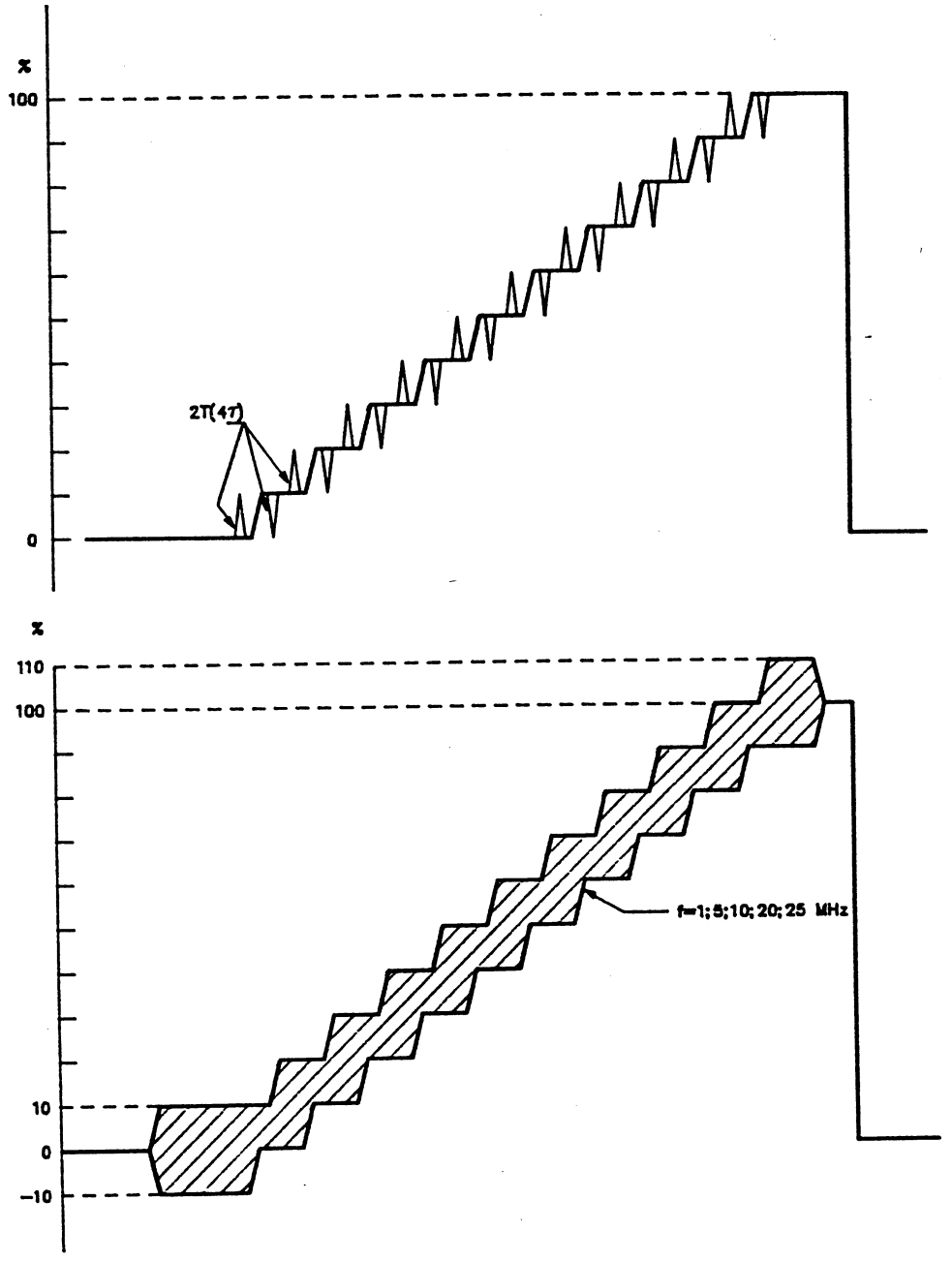

FIGURE 4 - Test signals for the measurement of non-linear distortions

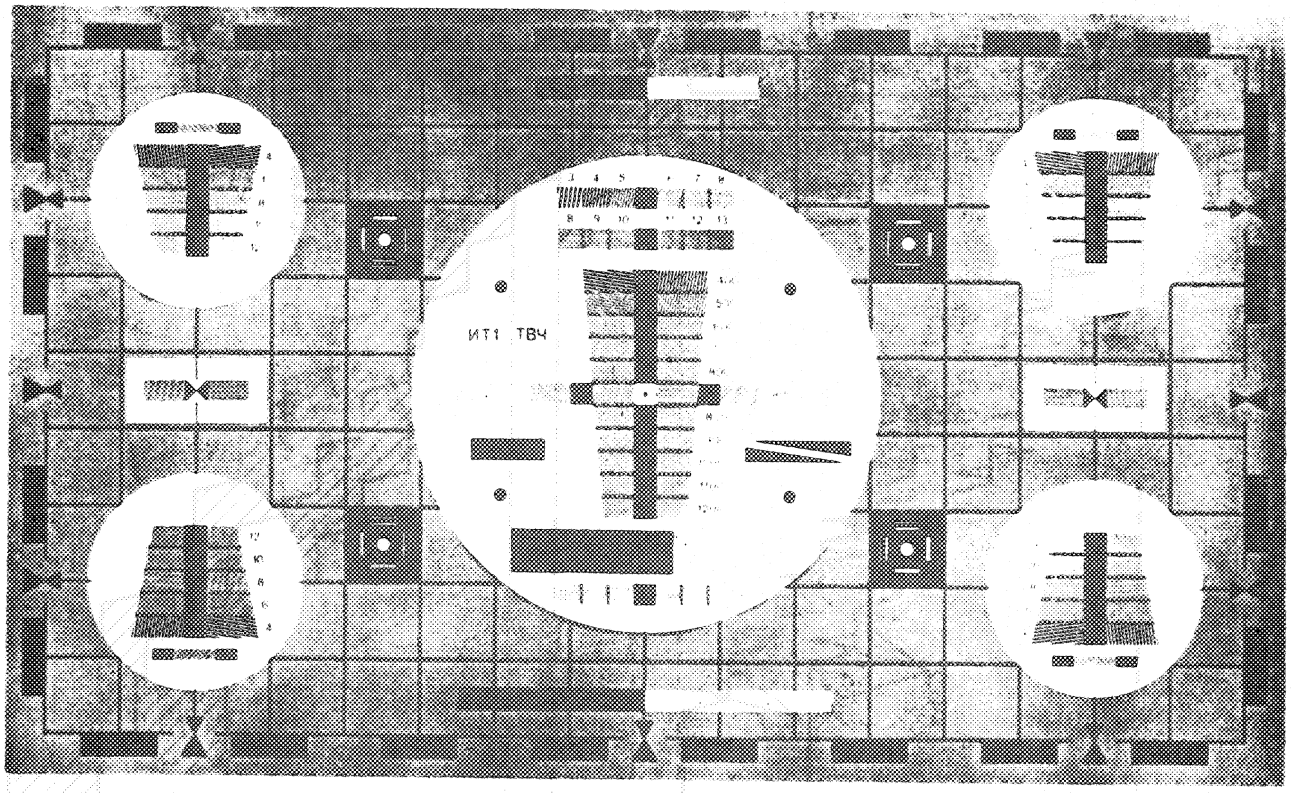

FIGURE 5 - Resolution Test Chart for HDTV

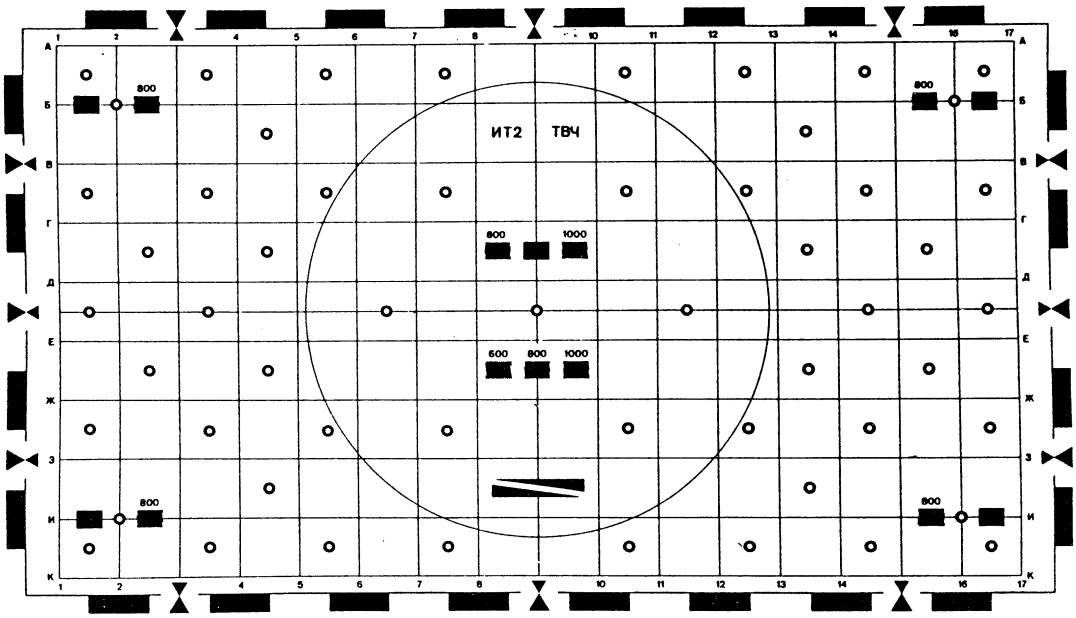

FIGURE 6 - Linearity Test Chart for HDTV

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CCIR Documents

[1986-90]: a. 11/6-2104 (USSR); b. 11/6-2105 (USSR); c. 11/6-2106 (USSR). d. 11/580 (Japan); e. 11/578 (Japan).