INTERNATIONAL STANDARD

IEC 61947-1

First edition
2002-08

Electronic projection – Measurement and documentation of key performance criteria –

Part 1: Fixed resolution projectors

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRONIC PROJECTION – MEASUREMENT AND DOCUMENTATION OF KEY PERFORMANCE CRITERIA

Part 1: Fixed resolution projectors

FOREWORD

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International Standard IEC 61947-1 was prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/501/FDIS	100/537/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2004. At that date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

This standard was developed to ensure a common, meaningful description of key performance parameters for fixed resolution projectors. The measurement methods and test signals correlate closely to typical uses involving computer-generated text and graphics displays. These measurements evaluate the actual viewable image that emanates from fixed resolution projectors. The resulting performance specifications are conservative in nature and allow any display device to be used beyond its rated specifications with degraded performance. The point at which this degraded performance is no longer useful is highly subjective and strongly affected by the environment and the application.

This standard is designed to specify a means of measuring and quantifying the performance of fixed resolution projectors and is not intended to provide design goals for manufacturers of such equipment.

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ELECTRONIC PROJECTION – MEASUREMENT AND DOCUMENTATION OF KEY PERFORMANCE CRITERIA

Part 1: Fixed resolution projectors

1 Scope

This part of IEC 61947 specifies requirements for measuring and documenting key performance parameters for electronic projection systems with fixed resolution projectors in which the light source and projection/magnification optics are an integral part of the system (i.e. individual pixel light sources or matrix displays such as liquid crystal, DMD, plasma, or electroluminescent panels). It also applies to LCD panels or other fixed resolution imaging devices themselves that are used with overhead projectors.

The provisions of this standard are designed to codify the measurement of the performance of variable resolution projectors and are not intended to provide design goals for manufacturers of such equipment.

This standard is intended for fixed resolution projectors that are primarily designed for use with discrete colour (RGB) raster-scanned video, text, and graphics signals generated by computer equipment.

NOTE These devices may also accept composite or component television video signals encoded in ITU/R publications, which are not within the scope of this standard. In this standard, all of these signals are referred to as television video (TV video).

Projectors and projection systems with multiple variable resolutions, such as cathode-ray tubes and laser projectors, are not fully addressed by this standard, and reference should be made to IEC 61947-2.

A discussion of considerations taken into account in the development of this standard appears in Annex C.

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2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61947-2, *Electronic projection – Measurement and documentation of key performance criteria – Part 2: Variable resolution projectors*

IEC 61966-4, *Multimedia systems and equipment – Colour measurement and management – Part 4: Equipment using liquid crystal display panels*

IEC 61966-5, *Multimedia systems and equipment – Colour measurement and management – Part 5: Equipment using plasma display panels*

ISO 3741, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms*

ISO 7779, *Acoustics – Measurement of airborne noise emitted by information technology and telecommunication equipment*

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1
active matrix display
display that uses switches at each pixel to select those pixels to which a voltage will be applied

3.2
active viewing area
horizontal and vertical dimensions in millimetres (inches) of the boundary of the array of pixels. It may also be expressed in square millimetres or square inches

3.3
aperture ratio (fill factor)
light transmitting/reflecting area of a pixel times the number of pixels divided by the active viewing area (light transmitting area and light blocking area)

3.4
aspect ratio
proportions of a projected picture area, for example, the width compared to the height

NOTE It is usually expressed in standard ratios such as 4:3, 16:9, or others.

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3.5
blanking
process of the beam turning off (blanking) which occurs during horizontal and vertical retrace (flyback)

3.6
CIE
Commission Internationale de l'Eclairage, the international commission on illumination

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NOTE The CIE is an organization devoted to international cooperation and exchange of information among its member countries on all matters relating to the art and science of lighting.

3.7
CIE chromaticity values
Cartesian coordinates used to define a colour in CIE colour space

NOTE The 1931 chromaticity values are designated x and y. In 1976, the CIE defined a more uniform colour space. The 1976 CIE chromaticity values are u' and v'.

3.8
colour mapping
means for accurately displaying colour signals or altering sets of colour signals in a controlled manner

3.9
contrast ratio
luminance or illuminance ratio of a light area of the image to the dark area of the same image

3.10
correlated colour temperature (CCT) of the white-point
temperature, in kelvins, of the black-body radiator the chromaticity of which is closest to the chromaticity of a particular light, for example, from a display screen, as measured in the 1960 CIE (u, v) uniform chromaticity space

NOTE An algorithm for computing CCT of the white-point, either from 1931 CIE (x, y) coordinates or from 1960 (u,v) coordinates, appears in Wyszecki and Stiles [1]. A graphical nomogram also appears in this work.

Alternatively, a successful numerical approximation has been derived by C. S. McCamy [2]. Given CIE 1931 coordinates (x, y), McCamy's approximation is CCT = 437 n^3 + 3601 n^2 + 6831 n + 5517 where n = (x - 0,3320)/(0,1858 - y). This approximation, the second of three proposed, is close enough for any practical use between 2000 K and 10 000 K. In units of 1960 u, v chromaticity, it is agreed that the concept of CCT of the white-point has little meaning beyond the distance of 0,01 from the Planckian locus (see Robinson et al [3]), where the distance is specified by:

$$\Delta uv = \sqrt{(u_1 - u_2)^2 + (v_1 - v_2)^2}$$

Most commercial colorimeters will report CCT of the white-point from 0,0175 u, v units above the Planckian locus to 0,014 u,v units below this locus.

3.11
digital micromirror device (DMD)
semiconductor light micromirror array. The DMD can switch incident light on or off in discrete pixels within microseconds to produce projection display systems

3.12
optical distortion
situation in which an image is not a true-to-scale reproduction of an object due to the optics of the system

NOTE There are many types of distortion, such as anamorphic, barrel, curvilinear, geometric, keystone, panoramic, perspective, radial, stereoscopic, tangential, and wide-angle.

3.13
f/number
stop number
the reciprocal value of the relative aperture

NOTE Relative aperture of a photographic lens: twice the numerical aperture where the numerical aperture is the sine of the semi-angle subtended by the exit pupil at the focal plane. For photographic applications, the aperture is equivalent (within a 1/3 stop) to the ratio of the diameter of the entrance pupil to the focal length. (See ISO 517: 1996(E) *Photography – Apertures and related properties pertaining to photographic lenses – Designations and measurements*.)

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3.14
fall time
time, in milliseconds, for the image brightness to change from 90 % of its maximum value to 10 % of its maximum value

3.15
focal length
distance between the centre of the focusing lens or mirror and the focal spot.

NOTE Shorter focal length projection lenses produce larger screen images for a given distance from the screen

3.16
focus
adjustment of an optical system to achieve the greatest possible sharpness

3.17
four corners
centres of the four corner points (see Figure A.2), located at 10 % of the distance from the corners to the centre of point 5

3.18
front screen projection
image projected on the audience side of a light-reflecting screen

3.19
illuminance
quotient of a luminous flux incident on an element of the surface containing the point by the area of that element

Unit: lux (lx)

3.20
light source life expectancy
time that the light source can keep its projected light output as measured in this standard, higher than 50 % of the initial value when tested with a duty cycle of 2 h on and 15 min off

3.21
liquid-crystal display (LCD)
display made of material the reflectance or transmittance of which changes when an electric field is applied

3.22
luminance
L
luminance in a given direction is the luminous intensity per unit of projected area of any surface, as viewed for that direction

Unit: candela per square metre (cd/m²).

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3.23
luminous flux
quantity derived from radiant flux by evaluating the radiation according to its action upon a selective receptor, the spectral sensitivity of which is defined by the standard 1931 CIE spectral luminance efficiency function for the photopic $V(\lambda)$ function

NOTE Quantity of light expressed in lumens, and directed in a given direction.

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3.24
luminous intensity
luminous flux per unit solid angle emitted or reflected from a point source

Unit: candela

3.25
object
slide or transmissive/reflective image forming panel, such as an LCD, that is illuminated and imaged by the optics onto a viewing screen

3.26
peak angle
angle at which maximum luminance is observed

3.27
photometric units
units of light measurement based on the response of the average human observer. The response of the average human observer is defined by the 1931 CIE spectral luminance efficiency function for the photopic $V(\lambda)$ function

3.28
pixel
smallest element of a display space that can be independently assigned a colour or intensity

3.29
projection distance
distance between the projector and the screen measured in linear units (i.e. metres, feet, or inches). This distance is considered to be the distance from the image displayed on the screen to the outermost element of the projection lens

3.30
rear screen projection
image projected through a light transmitting screen to the audience side of the screen

3.31
response time
sum of the rise and fall times divided by 2. It is measured at (23 ± 5) °C ambient temperature after 15 min in operation:

$$t_{\text{res}} = \frac{t_{\text{r}} + t_{\text{f}}}{2}$$

3.32
rise time
time, in milliseconds, for the image brightness to change from 10 % of its maximum value to 90 % of its maximum value

3.33
Scan rate

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3.33.1
vertical scanning
rate (hertz) at which one complete image (frame) is drawn

3.33.2
horizontal scanning
rate (kilohertz) at which each line of the display is scanned

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3.34
screen gain
measure of the projector screen luminance as compared to the luminance of a block of a perfect reflecting diffuser, (preferably a calibrated tablet of pressed barium sulfate, as specified in CIE 38: 1977, Section 12.2.5 or pressed polytetrafluoroethylene (PTFE) powder, see CIE 135/6: 1999) illuminated with the same projection source, which serves as the standard for a gain of 1,0

NOTE Gains are typically measured perpendicular to the centre of the screen.

3.35
standard viewing position
for display devices the screen of which is an integral part of the projection device, the standard viewing position is the reference position for measurements, and is specified by the standard viewing distance measured from the horizontal plane on which the display under test is placed

3.36
steradian
SI unit of solid angle: solid angle that, having its vertex at the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square with sides of length equal to the radius of the sphere

[IEV 845-01-20 (ISO 31/1-2.1,1978)]