IEC 61947-2

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electronic projection – Measurement and documentation of key performance criteria –
Part 2: Variable resolution projectors

Projection électronique – Mesure et documentation des critères principaux de performance –
Partie 2: Projecteurs à résolution variable

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61947-2 has been prepared by subcommittee 100C: Audio, video and multimedia subsystems and equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This bilingual version (2013-03) corresponds to the monolingual English version, published in 2001-09.

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

FDIS	Report on voting
100/268/FDIS	100/418/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.

The French version of this standard has not been voted upon.

Annexes A, B, D, and G form an integral part of this standard.

Annexes C, E, F, H, I and J are for information only.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2004. At this 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 variable resolution projectors (for example, CRT or laser 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 variable 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 variable resolution projectors and is not intended to provide design goals for manufacturers of such equipment.

ELECTRONIC PROJECTION – MEASUREMENT AND DOCUMENTATION OF KEY PERFORMANCE CRITERIA –

Part 2: Variable resolution projectors

1 Scope

This part of IEC 61947 specifies requirements for measuring and documenting key performance parameters for CRT and laser-based projectors and other variable resolution projectors that are capable of multiple variable resolutions and in which the image is raster-scanned.

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 variable resolution projectors (including projection displays that are capable of multiple variable resolutions) that are designed for use with primarily 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 to NTSC/RS170A, PAL, SECAM, or future HDTV, or ATV standards, which are fully described in their respective documentation and are not within the scope of this part of IEC 61947. In this part of IEC 61947, all of these signals are referred to as television video (TV video) (see IEC 60107-1 [27]).

Displays with fixed resolutions (i.e. individual pixel light sources or matrix displays such as liquid crystal, DMD, plasma, or electroluminescent panels), are not fully addressed by this standard, and reference should be made to IEC 61947-1.

Factors outside the scope of this standard that may have a bearing on projector performance are listed in annex E. A discussion of considerations informing the development of standard appears in annex C.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61947. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61947 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(845):1987, *International Electrotechnical Vocabulary (IEV) – Chapter 845: Lighting*

IEC 61947-1, *Electronic projection – Measurement and documentation of key performance criteria – Part 1: Fixed resolution projectors*[1)]

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1) To be published.

ISO 3741:1999, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Precision methods for reverberation rooms*

ISO 7779:1999, *Acoustics – Measurement of airborne noise emitted by information technology and telecommunications equipment*

3 Definitions

For the purposes of this part of IEC 61947, 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. It is usually expressed in standard ratios such as 4:3, 16:9, or others

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 (International Commission on Illumination)

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 the 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 n3 + 3 601 n2 + 6 831 n + 5 517, where n = (x - 0,3320)/(0,1858 – y). This approximation, the second of three proposed, is close enough for any practical use between 2 000 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 colourimeters will report the 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
focal length of a projection lens divided by the diameter of the lens aperture

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. 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
luminance (L) 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/m^2)

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(λ) function

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

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(λ) 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:

$$t_{res} = \frac{t_r + t_f}{2}$$

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

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

3.34
screen gain
measure of the projector screen luminance as compared to the luminance of a block of magnesium carbonate 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]

3.37
transmission
measure of the amount of light that is transmitted by an optical medium relative to the total amount of incident light

3.38
vertical lines
number of active lines in a picture

3.39
viewing angle/half gain
angle between the direction of maximal reflection and the direction where the luminance drops to 50 % of its value

NOTE This quantity should be measured in the centre of the viewing screen.

3.40
visible light
electromagnetic radiation to which the human observer is sensitive through the visual sensations that arise from the stimulation of the retina of the eye

NOTE The spectral range is typically considered to have a range of 380 nm to 780 nm (3 800 Å to 7 800 Å).

3.41
zoom lens
focusing lens that has a second, primary adjustment for focal length

NOTE This capability allows smaller or larger image sizes from a fixed projection distance. The zoom ratio is typically stated in a range of screen width/projection distance ratios, for example, a 1:2 to 1:4 zoom lens could focus a 10 m or a 5 m wide image from a 20 m throw distance.

4 General requirements

This part of IEC 61947 is intended to specify a complete description of the product. In accordance with these intentions, a complete specification (see example in annex D) shall be used in product descriptions. If a particular specified measurement was not performed, the complete specification shall include the text "not measured" or "data not available" under that measurement section.

NOTE The use of partial specifications in product descriptions is not recommended since many of the specified measurements are interrelated (for example, resolution and light output).

All measurements and specifications shall conform to the following.

– The measurements of light output, visual resolution, and blanking found in this standard are interrelated and shall be measured and specified as a set.

– The parameters and measurement criteria specified in this document allow for a wide variety of equipment performance. Secondary, non-conforming specifications are permitted to allow flexibility for special features of various products and technologies, but shall be displayed in the same type face font and density at least 25 % smaller in size.

– A sample from normal production runs shall be used to establish the specifications. Results from measurements of preproduction and prototype units shall be identified as preliminary specifications.

– The sample units shall not be adjusted or enhanced beyond normal production parameters, especially in a way that would reduce the normal operating life of any component or of the entire display.

– All optical, electrical focus, and convergence controls shall be adjusted for the sharpest display over the largest possible percentage of the illuminated area, using appropriate patterns from an internal or external test generator as needed.

- The equipment shall be allowed to stabilize without further adjustment for a minimum of 15 min, at a nominal ambient room temperature of (23 ± 5) °C, before taking measurements.

  NOTE Measurement could also be taken after 1 h of operation with all covers in place, white raster, as intended for normal use.

- Measurements shall take place in a lightproof room where the only source of illumination is the projector. Less than 1 % of the light on the screen shall be from any source other than the projector. The projector should be operated with all covers in place as in normal operation.
- The display device shall be adjusted for a 4:3 (horizontal:vertical) aspect ratio, if it is capable of it. The horizontal and vertical size of the scanned area shall be adjusted to the maximum usable diagonal size of the light modulator or source, such as a light valve or CRT, with the specified aspect ratio.
- Displays designed for only one aspect ratio shall be adjusted to, and measured at, the design aspect ratio that shall be specified with the light output.
- Devices that use a separate screen shall be positioned relative to the screen in accordance with the angle, height, and distance specified in the manufacturer's set-up instructions.
- Displays with integral screens shall be adjusted so as to fill exactly their viewing screens. The displays shall not delete nor hide any data in the corners or edges in the horizontal dimension. The vertical dimension shall then be adjusted to achieve a 4H:3V aspect ratio, if applicable.
- All measurements shall be taken with no adjustments made between measurements.
- Measurements shall be specified in international units, or both international and national units, with international units listed first.

5 Light output measurement and specification

The light output specification shall be stated in lumens for projectors with separate screens, and in candela per square metre (nits) for displays with self-contained screens.

The following conditions shall be met.

- Input signals shall be supplied by a standard test signal source, as specified in annex B.
- The light meter shall be photopically and cosine corrected, calibrated, and traceable to a national standard.
- A special test pattern (see figure A.1) shall be used to set the controls for making measurements. The black level (or brightness control) shall be set to the point where the maximum number of signal level blocks on the top line, representing 0 %, 5 %, 10 % and 15 % signal levels, are visible and distinct from the adjacent signal level blocks.

The video gain (contrast or picture control) shall be advanced from minimum until the maximum number of signal level blocks in the lower line of the pattern, representing the 85 %, 90 %, 95 %, and 100 % signal levels, are visible and distinct from the adjacent signal level blocks, or until the picture no longer increases in brightness as limited by automatic brightness circuitry.

In the event of controls interacting, they shall be readjusted in sequence in order to achieve the described conditions on the screen. The controls shall remain at these settings for all measurements. The total number of signal level blocks distinguishable in this pattern shall be stated in the specification.

A 100 % full-white image shall be used for the CCT and screen illuminance measurements.