IEC 62496-2-4

Edition 1.0 2013-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Optical circuit boards – Basic test and measurement procedures – Part 2-4: Optical transmission test for optical circuit boards without input/output fibres

Cartes à circuits optiques – Procédures fondamentales d'essais et de mesures – Partie 2-4: Essai de transmission optique des cartes à circuits optiques sans fibres d'entrée/sortie

IEC 62496-2-4:2013

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OPTICAL CIRCUIT BOARDS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 2-4: Optical transmission test for optical circuit boards without input/output fibres

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International Standard IEC 62496-2-4 has been prepared by IEC technical committee 86: Fibre optics.

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

FDIS	Report on voting
86/449/FDIS	86/456/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.

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Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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OPTICAL CIRCUIT BOARDS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 2-4: Optical transmission test for optical circuit boards without input/output fibres

1 Scope

This part of IEC 62496 specifies the test method to decide whether to pass or fail an optical circuit board using direct illumination by a light. The input ports are directly illuminated and the optical intensity from the output ports of the optical circuit board is monitored using an area image sensor. Excess optical losses are the calculated from total detected intensities of light from a sample to be measured and from a control sample. This method is used to illuminate uniformly the input port of the optical circuit board (OCB) with a larger area than the core area, obtain the radiance of an area image from the corresponding output port of the OCB using an area image sensor, and evaluate whether to pass or fail using the radiance obtained compared to that of a control sample.

The advantage of this test method is that the alignment procedure between a launch fibre and the OCB is not necessary.

2 Normative references

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

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms, definitions and abbreviations apply.

3.1.1
shading
non-uniformity of detected intensity of an image caused by non-uniformity of the sensitivity of elements of an area image sensor and vignetting depending on the optical system

Note 1 to entry: Correction of the non-uniformity of the detection sensitivity of elements of a uniform one is called "shading correction".

3.1.2
gamma value
factor "γ" for a camera expressed by the following equation:

$$(\text{input optical intensity signal}) = A \times (\text{output image signal})^{\gamma}$$

where A is a proportionality constant

Note 1 to entry: The input optical intensity is linearly proportional to the output image signal when $\gamma = 1$.

3.1.3
telecentric optical system
optical system where the optical input pupil and output pupil are placed at infinitely far positions and the main optical signal is parallel to the optical axis

3.1.4
distortion
(distortion aberration)
type of aberration

Note 1 to entry: The optical image is not in proportion to the original target but is distorted. There are two types of distortion: one is the barrel type, where light is distorted outward; the other is the bobbin or pincushion type, where light is distorted inward near the edge of a lens.

3.1.5
area image sensor
arrayed photo-detector in two dimensions, which can capture area image at once

Note 1 to entry: There are two types of area image sensor: one is the CCD (charge coupled device); the other is the CMOS (complementary metal oxide semiconductor).

3.1.6
control sample
sample having optical insertion loss already obtained by measurement procedure specified in IEC 62496-2-1 [1][1]

Note 1 to entry: The core shape and numerical aperture of the control sample should be same as those of the samples to be measured.

3.1.7
relative optical loss
difference between the total detected intensity obtained from the output port area of the sample to be measured and that for a control sample

Note 1 to entry: The unit of relative optical loss is the decibel.

3.2 Abbreviations

ACC	automatic current control
APC	automatic power control
CCD	charged couple device
CMOS	complementary metal oxide semiconductor
LED	light emitting diode
NA	numerical aperture
OCB	optical circuit board

4 Measurement conditions

All measurements are made under the conditions specified in IEC 60068-1, unless otherwise specified.

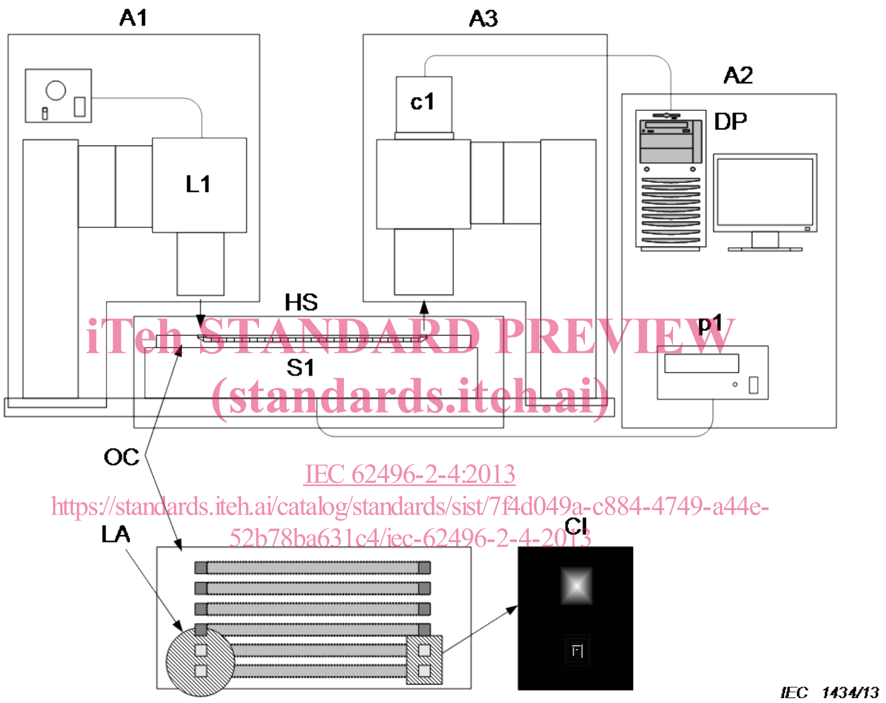
1 Figures in square brackets refer to the Bibliography.

5 Inspection methods

5.1 Equipment

The test equipment shall consist of a light source system, an observation system, a sample holder and a data processor (image intake and image processor). The construction illustrated in Figure 1 should be used to the surface I/O port type OCB. The system illustrated in Figure 2 should be used for end-face I/O type OCB.

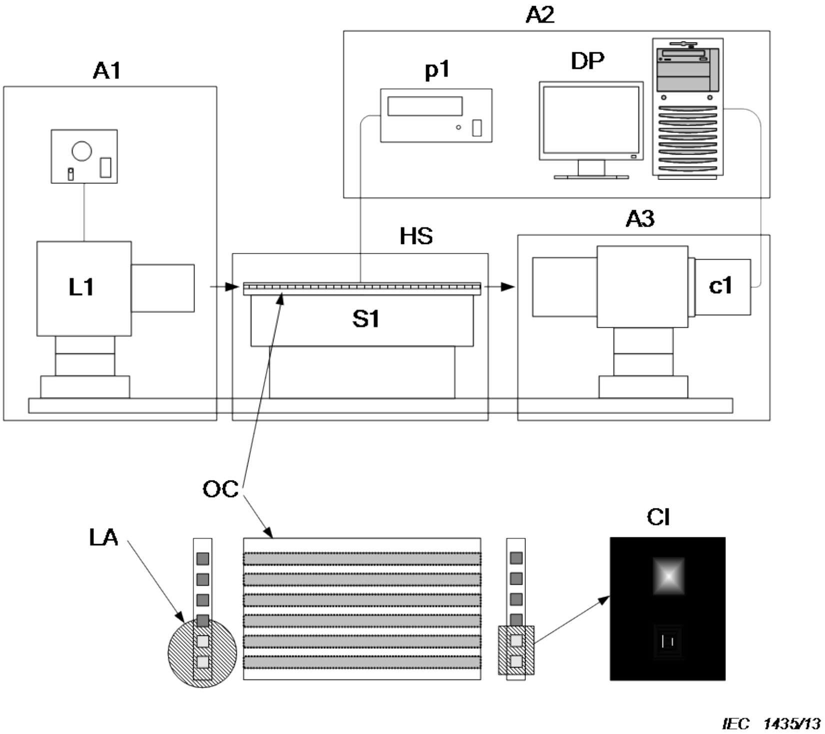
Movement and adjustment of positions of irradiation for and detecting images from the sample should be carried out by the adjustment mechanisms provided to the light signal illuminator, observation optics and sample holder.



Key

A1 light source system
A2 data processing system
A3 observation system
L1 light source
HS unit for holding sample
DP data processor
p1 stage controller
S1 stage
c1 camera
OC optical circuit board
LA uniform light
CI captured image

Figure 1 – Optical transmission test system without I/O fibres for surface I/O type OCB



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A1 light source system
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HS unit for holding sample
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c1 camera
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LA uniform light
CI captured image

Figure 2 – Optical transmission test system without I/O fibres for end-face I/O type OCB

5.1.1 Light source system

5.1.1.1 Light source

The light source to be used is an incoherent light source, such as an LED, in order to prevent inducing a speckle pattern to the output image pattern to give a large numerical aperture divergent input to ensure fully filled waveguide modes. It is desirable that the light source is equipped with an APC to stabilize the output optical power by signal feedback from an optical power monitor. ACC is substituted for APC if the required optical stability is attained without use of an APC.

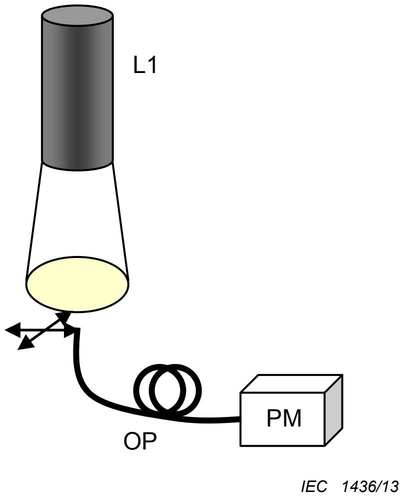
5.1.1.2 Holding and position adjustment of the light source

Holding and position adjustment functions of the light source shall be provided to adjust and control the light source position to the light input port of the sample to be measured.

5.1.1.3 Illumination condition

An illumination method shall be used that provides uniform light illumination to the optical circuit within a specified illumination intensity range. Ensure numerical aperture (NA) is greater than that of the optical circuit. The uniformity of illumination is confirmed by measuring, using a scanning optical fibre having similar core shape and NA to those of the OCB pointing in the same direction as the waveguide or fibres in the OCB to be measured or by using the OCB to be measured as a probe. A schematic diagram of measurement of uniformity of the illumination area is shown in Figure 3. An example of the measurement result is shown in

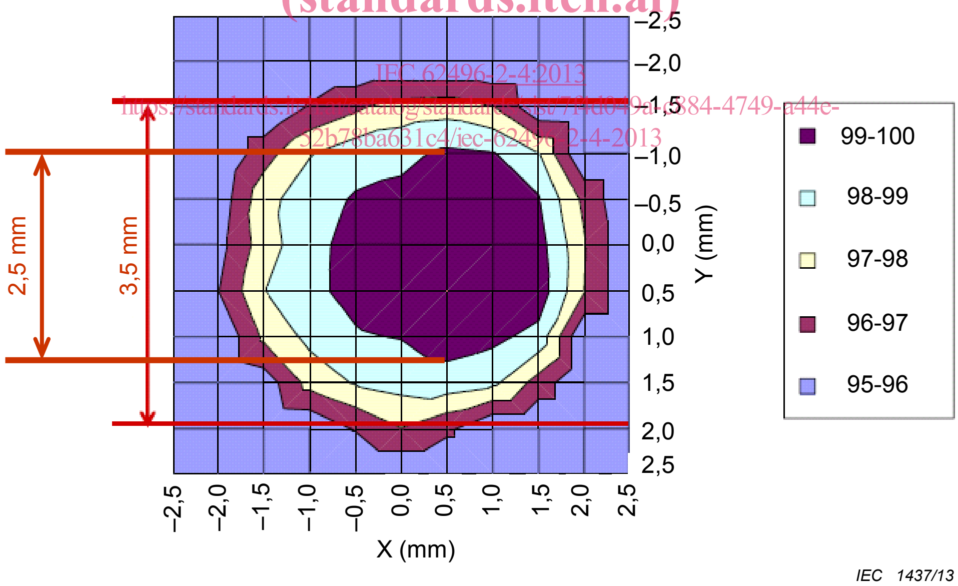
Figure 4. The uniformity of the illumination to be used should be sufficient for the required accuracy of the measurement.



Key

L1 light source
OP optical fibre as a probe
PM optical power meter

Figure 3 – Schematic diagram of measurement of uniformity of illumination area



NOTE 1 The unit in the legend is in percentage.

NOTE 2 The maximum intensity is normalized to 100 %.

Figure 4 – Example of obtained uniformity of illumination area

5.1.2 Observation system

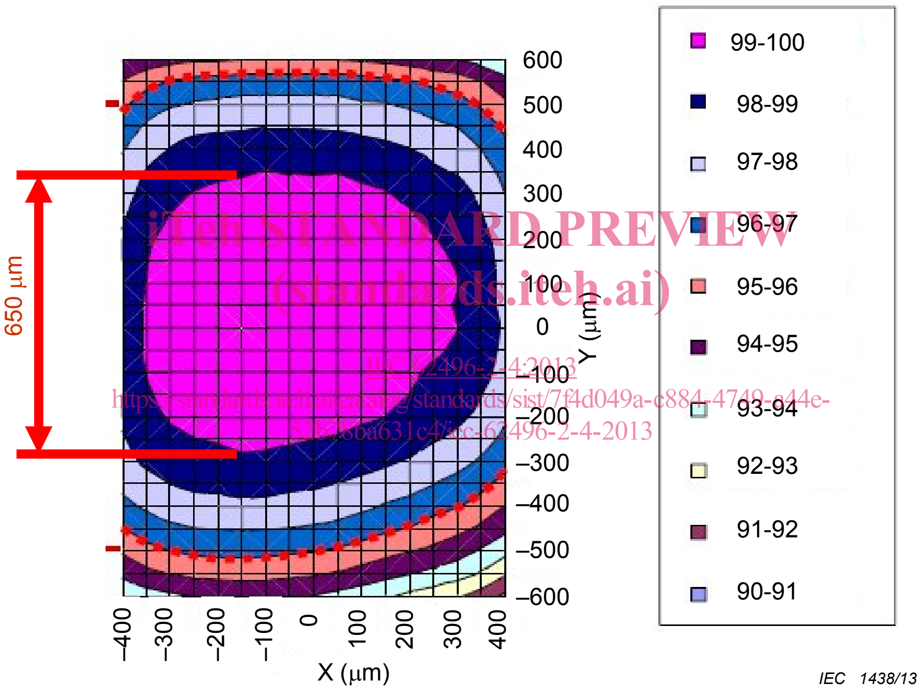
5.1.2.1 Optical system for observation of the image from the output ports

It is desirable to use a telecentric optical system to attain good measurement accuracy within the image measuring area. It is also recommended to use an optical system with minimum shading in the system to keep uniformity of the optical performance within the measuring area.

The NA of the optical system should be larger than that of the optical wiring to receive all the light output coming from the output port. The magnification of the observation system shall be chosen depending on the core size to be measured and the specification of the area image sensor (pixel number and size). The number of pixels in the output emission area, which is the extracted area by the image binarization method for one core shape of OCB, should be larger than 200.

5.1.2.2 Area image sensor

The area image sensor used in the measuring system may be a digital still camera using an area image sensor or a digital video camera. The area image sensor shall have the necessary sensitivity to the light used for optical information transmission. The image sensor to be used shall have a sufficient range of linearity to attain enough resolution of detected intensity for analysis of data. The area image sensor linearity between input optical light signal and output image signal shall be suitably ensured. Figure 5 shows an example of the sensitivity of an image sensor.



NOTE 1 The unit in the legend is in percentage.

NOTE 2 The maximum intensity is normalized to 100 %.

Figure 5 – Example of obtained sensitivity of an image sensor (input uniformity within 1 %)

5.1.2.3 Holding and position adjustment of the optical system

Holding and position adjustment functions of the optical system shall be provided to adjust and control the optical system position to the light output port of the sample to be measured.

5.1.3 Data processing unit

The data processing unit shall be used to judge if a test sample meets the requirements based on the selection of the optical output area from which light is emitted, calculation of total detected intensity in the area from which light is emitted, and relative optical loss evaluation in the output port area from which light is emitted. The analysis may be made after recording an optical image. However, it is desirable to perform necessary image processing while the measuring point is moved from one point to another, if the analysing equipment has