

INTERNATIONAL STANDARD

**Semiconductor devices -
Part 5-18: Optoelectronic devices - Light emitting diodes - Test method of the
macro photoluminescence for epitaxial wafers of micro light emitting diodes**

get full document from standards.iteh.ai



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2026 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search -

webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	2
1 Scope	4
2 Normative references	4
3 Terms, definitions and abbreviated terms	4
3.1 Terms and definitions	4
3.2 Abbreviated terms	6
4 Measuring methods	6
4.1 General	6
4.2 Principle	6
4.3 Requirements	7
4.3.1 Measuring conditions	7
4.3.2 Measuring instruments and equipment	7
4.4 Measurement setup	9
5 Test	11
5.1 Test items	11
5.2 Test sequence	11
5.3 Test report	13
Annex A (informative) Test example	14
Bibliography	17
Figure 1 – Schematic illustration of the PL processes in semiconductors	7
Figure 2 – Schematic diagram of the macro PL measurement setup	10
Figure 3 – An example of the PL spectrum from a blue LED wafer	10
Figure 4 – Sequence of the measurement of the macro PL of the micro LED epitaxial wafer	12
Figure A.1 – Peak PL signal distribution over a blue LED wafer	14
Figure A.2 – Peak PL wavelength distribution over a blue LED wafer	15
Figure A.3 – Centroid wavelength distribution over a blue LED wafer	15
Figure A.4 – FWHM distribution over a blue LED wafer	15
Figure A.5 – Integrated PL signal distribution over a blue LED wafer	16
Table 1 – Summary of test report	13

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**Semiconductor devices -
Part 5-18: Optoelectronic devices - Light emitting diodes -
Test method of the macro photoluminescence for epitaxial wafers
of micro light emitting diodes**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60747-5-18 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
47E/892/FDIS	47E/897/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60747 series, published under the general title *Semiconductor devices*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

Sample Document

get full document from standards.iteh.ai

1 Scope

This part of IEC 60747-5 specifies the measuring methods of macro photoluminescence (PL) for red, green, and blue epitaxial wafers of micro light emitting diodes (LEDs) prior to chip fabrication processes. Wafer sizes being considered are 4 in, 6 in, and 8 in in diameter.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 Terms and definitions

3.1.1

PL signal

optical radiation emitted from the sample via photoluminescence

Note 1 to entry: PL signal is proportional to the radiant power.

3.1.2

spectral PL signal

$$\Phi_{\text{PL},\lambda}(\lambda) = \frac{d\Phi_{\text{PL}}(\lambda)}{d\lambda}$$

PL signal measured by a spectrometer per unit wavelength

Note 1 to entry: The unit for the spectral PL signal is arb. unit/nm.

Note 2 to entry: Spectral PL signal is proportional to the spectral radiant power.

3.1.3

peak PL signal

maximum value of the spectral PL signal

3.1.4

threshold

minimum spectral PL signal over which the integrated PL signal is evaluated

3.1.5

minimum wavelength limit

$$\lambda_{\text{min}}$$

lower limit of the integration in calculating the integrated PL signal

3.1.6

maximum wavelength limit

$$\lambda_{\text{max}}$$

upper limit of the integration in calculating the integrated PL signal

3.1.7 peak PL wavelength

 λ_p

wavelength at which the spectral PL signal is the maximum

3.1.8 integrated PL signal

 Φ_{PL}

spectral PL signal integrated over the wavelength

$$\Phi_{PL} = \int_{\lambda_{\min}}^{\lambda_{\max}} \Phi_{PL,\lambda}(\lambda) d\lambda$$

Note 1 to entry: The minimum and maximum wavelengths are recommended to be smaller and greater than the peak PL wavelength by 40 nm.

Note 2 to entry: A threshold value, 2 % of the peak PL signal, is recommended to remove the noise signal before the integration.

Note 3 to entry: The unit for the integrated PL signal is arb. unit.

3.1.9 centroid wavelength

 λ_c

wavelength at which the mean photon energy of the spectrum is specified [1]

$$\lambda_c = \frac{\int \lambda \Phi_{PL,\lambda}(\lambda) d\lambda}{\Phi_{PL}}$$

Note 1 to entry: For integration, the criteria of the upper/lower limits and the threshold value are the same as the integrated PL signal.

Note 2 to entry: The mean photon energy $h\bar{\nu}$ is related to the centroid wavelength as $h\bar{\nu} = \frac{hc}{\lambda_c}$, where h is the

Planck constant and c is the speed of light in vacuum. The mean photon energy is defined by $h\bar{\nu} = \frac{\Phi_e}{\int \frac{\lambda}{hc} \Phi_{e,\lambda} d\lambda}$

in IEC 60747-5-8:2019, where Φ_e is the radiant power and $\Phi_{e,\lambda}$ is the spectral distribution (spectral radiant power). The mean photon energy has a meaning of the radiant power divided by the total number of photons emitted by the LED per unit time.

3.1.10 full width at half maximum FWHM

range of a variable over which a given characteristic is greater than 50 % of its maximum value

Note 1 to entry: FWHM may be applied to characteristics such as radiation patterns, spectral linewidths, etc. and the variable may be wavelength, spatial or angular properties, etc., as appropriate.

[SOURCE: IEC 60050-731:1991 [3], 731-01-57]

3.1.11 edge exclusion

distance from the edge of the wafer where no measurement is conducted

3.1.12 active region

region of the LED where LED radiation is emitted