

# INTERNATIONAL STANDARD



---

**Semiconductor devices –  
Part 18-3: Semiconductor bio sensors – Fluid flow characteristics of lens-free  
CMOS photonic array sensor package modules with fluidic system**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 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 Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://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](http://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 It also gives information on projects, replaced and withdrawn publications.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](http://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](http://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](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

# INTERNATIONAL STANDARD



---

**Semiconductor devices –  
Part 18-3: Semiconductor bio sensors – Fluid flow characteristics of lens-free  
CMOS photonic array sensor package modules with fluidic system**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 31.080.99

ISBN 978-2-8322-7673-0

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

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references .....	7
3 Terms and definitions .....	7
4 Measurement setup .....	8
4.1 General.....	8
4.2 Measurement system.....	9
4.3 Measurement parameters of sensor .....	9
4.4 Evaluation process.....	10
5 Measurement and calculation at initial state flow in fluidic system .....	11
5.1 General.....	11
5.2 Measurement and calculation of the flow propagation characteristics.....	12
5.3 Calculation of horizontal flow velocity for global shutter system .....	15
5.4 Calculation of horizontal flow velocity for rolling shutter system .....	17
5.5 Calculation of vertical flow velocity for rolling shutter system .....	18
5.6 Criteria for quality assurance of fluidic system .....	19
6 Measurement and calculation at steady-state flow in fluidic system .....	19
6.1 General.....	19
6.2 Measurement and calculation of all pixels at every frame.....	20
6.3 Calibration of lens-free CMOS photonic array sensor package modules with fluidic system.....	20
6.3.1 General .....	20
6.3.2 Calibration for planarization of non-uniform fluidic system .....	20
6.3.3 Final evaluation of calibrated sensor package modules with fluidic system.....	21
7 Test report.....	21
Bibliography.....	22
Figure 1 – Example of lens-free CMOS photonic array sensor package modules with fluidic system of porous media.....	8
Figure 2 – Example of measurement setup for lens-free CMOS photonic array sensor package module with fluidic system .....	9
Figure 3 – Example of photoelectric measurement schematics.....	9
Figure 4 – Example of measurement parameters of sensor.....	10
Figure 5 – Evaluation process of fluid flow characteristics of lens-free CMOS photonic array sensor package modules with fluidic system .....	11
Figure 6 – Example of frame capture performed at every frame .....	13
Figure 7 – Flow propagation profile in the early stage of the initial state flow .....	13
Figure 8 – Flow propagation profile in the intermediate stage of the initial state flow.....	14
Figure 9 – Flow propagation profile in the final stage of the initial state flow .....	15
Figure 10 – Example of exposure and horizontal flow in global shutter system.....	16
Figure 11 – Example of exposure and horizontal flow in horizontal rolling shutter system.....	17
Figure 12 – Example of exposure and vertical flow in vertical rolling shutter system .....	18

Figure 13 – Example on box plot of column pixels at every frame from sensor output values of all pixel arrays ..... 20

Figure 14 – Example on boxplot of all pixels at every frame from sensor output values of all pixel arrays ..... 20

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## SEMICONDUCTOR DEVICES –

**Part 18-3: Semiconductor bio sensors – Fluid flow characteristics  
of lens-free CMOS photonic array sensor package modules  
with fluidic system**

## 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) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60747-18-3 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices.

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

FDIS	Report on voting
47E/682/FDIS	47E/690/RVD

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

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

A list of all parts of 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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

A bilingual version of this publication may be issued at a later date.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

The IEC 60747-18 series on semiconductor bio sensors is composed of the following parts:

- IEC 60747-18-1 defines the test method and data analysis for calibration of lens-free CMOS photonic array sensors
- IEC 60747-18-2 defines the evaluation process of lens-free CMOS photonic array sensor package modules
- IEC 60747-18-3 defines the fluid flow characteristics of lens-free CMOS photonic array sensor package modules with fluidic system

The IEC 60747-18 series includes subjects such as noise analysis, long-term reliability tests, test methods for lens-free CMOS photonic array sensor package modules under patchable environments, test methods under implantable environments, etc.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents given in several subclauses as indicated in the table below. These patents are held by their respective inventors under license to SOL Inc.:

KR1020170125673	[SOL]	METHOD FOR EVALUATING FLUID FLOW CHARACTERISTICS OF LENS-FREE CMOS PHOTONIC ARRAY SENSOR PACKAGE MODULE WITH FLUIDIC SYSTEM	Subclause 4.4 Clause 5, 6
PCT/KR2017/011031	[SOL]	METHOD FOR EVALUATING FLUID FLOW CHARACTERISTICS OF LENS-FREE CMOS OPTICAL ARRAY SENSOR PACKAGE MODULE HAVING FLOW CHANNEL	Subclause 4.4 Clause 5, 6
US/16338064	[SOL]		

IEC takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the IEC that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with IEC. Information may be obtained from:

SOL Inc.  
H Business Park  
C1010, 26, Beobwon-ro 9-gil, SongPa-Gu  
Seoul 05838  
Republic of Korea

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO ([www.iso.org/patents](http://www.iso.org/patents)) and IEC (<http://patents.iec.ch>) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

## SEMICONDUCTOR DEVICES –

### Part 18-3: Semiconductor bio sensors – Fluid flow characteristics of lens-free CMOS photonic array sensor package modules with fluidic system

#### 1 Scope

This part of IEC 60747 specifies the fluid flow characteristics of lens-free CMOS photonic array sensor package modules with fluidic system for bio analysis. This document includes the measurement set-up, measurement and calculation at initial state flow, criteria of the fluidic system for quality assurance, measurement and calculation at steady-state flow, and test report.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60747-18-1:2019, *Semiconductor devices – Part 18-1: Semiconductor bio sensors – Test method and data analysis for calibration of lens-free CMOS photonic array sensors*

IEC 60747-18-2<sup>1</sup>:-, *Semiconductor devices – Part 18-2: Semiconductor bio sensors – Evaluation process of lens-free CMOS photonic array sensor package modules*

#### 3 Terms and definitions

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

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

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

##### 3.1

##### **lens-free CMOS photonic array sensor package modules with fluidic system**

device composed of the lens-free CMOS photonic array sensor, middle layer, user light (first light source, second light source), its own dark box and fluidic system on or over the sensor

SEE: Figure 1.

Note 1 to entry: Lens-free CMOS photonic array sensor package modules with fluidic system are extensively utilized in bio-diagnostic devices, healthcare devices, lens-free microscopes, and patchable/implantable medical devices as shown in Figure 1.

---

<sup>1</sup> Under preparation. Stage at the time of publication: IEC/RFDIS 60747-18-2:2019.