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INTERNATIONAL STANDARD

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

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CONTENTS

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SEMICONDUCTOR DEVICES –

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

FOREWORD

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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- withdrawn,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
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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]		

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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 [1], *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.

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- 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.

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

Note 2 to entry: The sensing environments of such a lens-free CMOS photonic array sensors are typically different from those of general-purpose image sensors which are normally mounted with an external lens in module housings.

Note 3 to entry: The first light source (first user light) and second light source (second user light) are described in Figure 1 of IEC 60747-18-2:–.

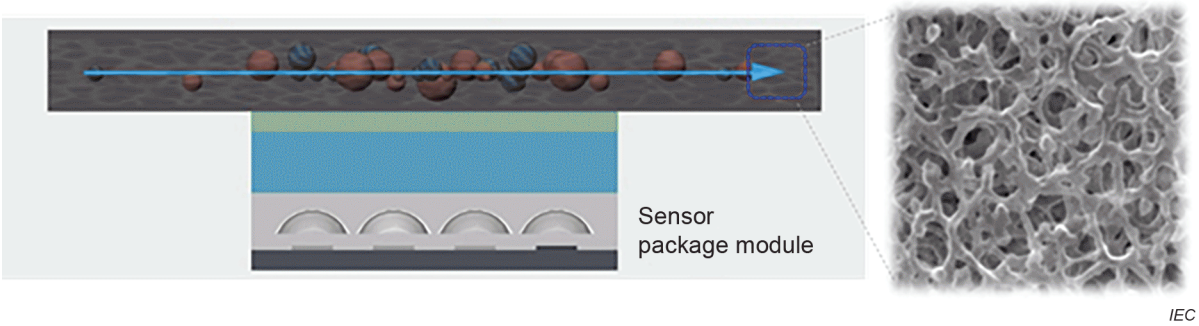

Figure 1 – Example of lens-free CMOS photonic array sensor package modules with fluidic system of porous media

3.2
linearity
ability of a pixel of an array sensor to provide an output having a linear relationship with an input light power

[SOURCE: IEC 60747-18-1:2019, 3.3]

3.3
Reynolds number
Re

quantity of dimension 1 characterizing the flow of a fluid in a given configuration characterized by a specified length l, defined by $Re = \frac{\rho \times v \times l}{\eta} = \frac{v \times l}{\upsilon}$, where the fluid is described by its mass density ρ, speed v, dynamic viscosity η, and kinematic viscosity υ

Note 1 to entry: The Reynolds number characterizes the relative importance of inertia and viscosity in a fluid flow.

Note 2 to entry: When the Reynolds number is less than a critical value Re_{crit}, laminar flow is stable. For higher values of Re, laminar flow becomes unstable. The critical value depends on the configuration.

Note 3 to entry: In case of a fluid flowing through a circular tube with diameter d, the specified length is $l = d$, and the critical value of the Reynolds number is $Re_{crit} \approx 2\,300$.

[SOURCE: IEC 60050-113:2011, 113-03-36]

4 Measurement setup

4.1 General

The lens-free CMOS photonic array sensor package module with fluidic system is shown in Figure 2 as an example. The fluidic system can be a paper-based membrane strip, gel matrix with pore and microchannel (with forced flow or capillary flow) for biological detection. A Reynolds number equation is employed to optimize the measurement condition of the sensor to avoid spatial distortion caused by motion blur that is the apparent steaking of rapidly moving objects in the sensor output value (overlapping exposure for two frames). Here the velocity of the fluid is a major parameter that needs to be tested in case other specific channel conditions are fixed. Using this velocity parameter obtained from the test based on Reynolds equation, the specific sensor condition that minimizes the motion blur phenomenon can be determined.

4.2 Measurement system

All measurements shall be performed under the standard conditions, according 4.2 of IEC 60747-18-1:2019, as shown in Figure 2 and Figure 3. All items mentioned in 4.2 of IEC 60747-18-1:2019 shall also be also defined.

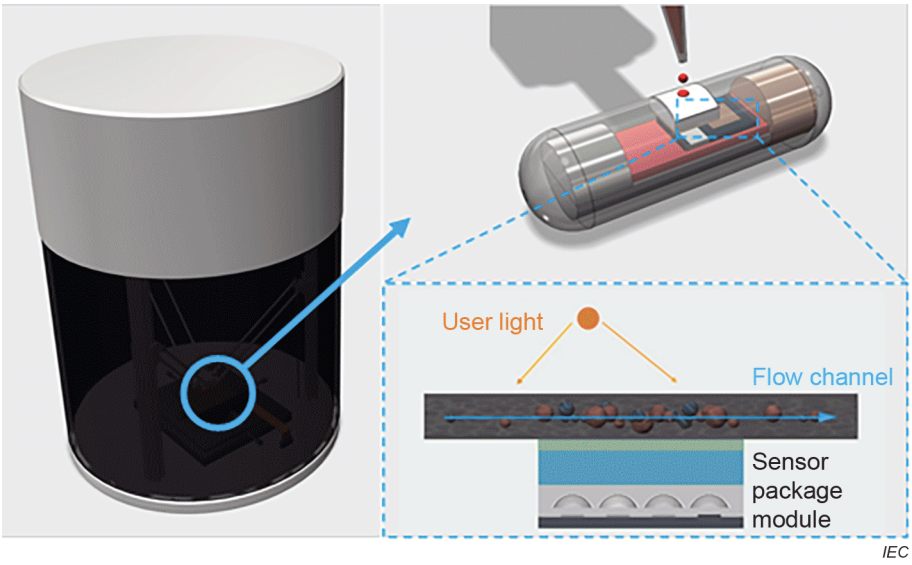

Figure 2 – Example of measurement setup for lens-free CMOS photonic array sensor package module with fluidic system

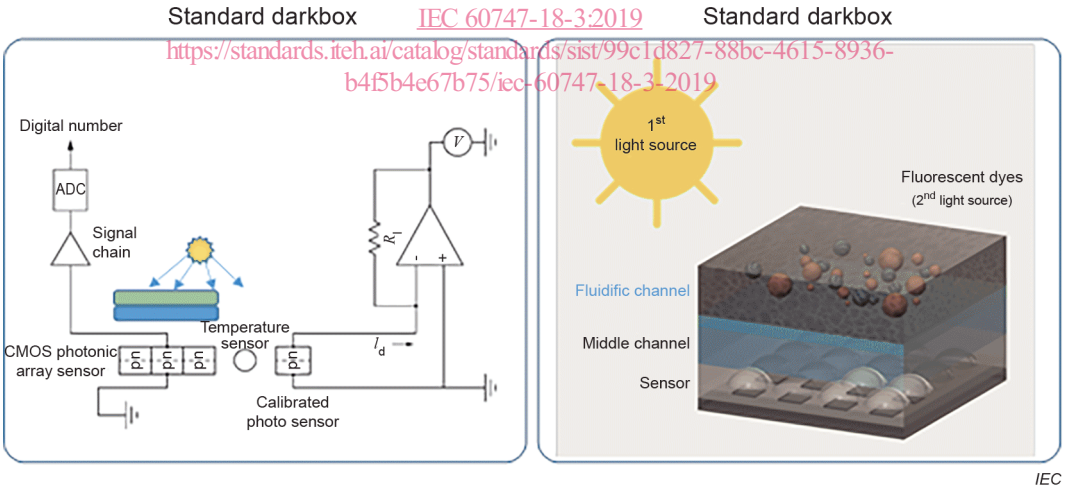

Figure 3 – Example of photoelectric measurement schematics

The photoelectric characteristics of lens-free CMOS photonic array sensor package modules with fluidic system can be measured using the measurement system shown in Figure 3 during fluid flow.

4.3 Measurement parameters of sensor

The measurement parameters listed below shall be specified and included in the test report. Some of the parameters are shown in Figure 4:

– unit pixel size of sensor

– effective pixel area of sensor