



BSI Standards Publication

Semiconductor devices

Part 19-2: Smart sensors — Indication of specifications of sensors and power supplies to drive smart sensors for low power operation

National foreword

This Published Document is the UK implementation of IEC TS 60747-19-2:2021.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication is not to be regarded as a British Standard.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 05613 6

ICS 31.080.99

Compliance with a Published Document cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 June 2021.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------



IEC TS 60747-19-2

Edition 1.0 2021-05

TECHNICAL SPECIFICATION

**Semiconductor devices –
Part 19-2: Smart sensors – Indication of specifications of sensors and power
supplies to drive smart sensors for low power operation**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.080.99

ISBN 978-2-8322-9803-9

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

CONTENTS

FOREWORD 3

INTRODUCTION 5

1 Scope 8

2 Normative references 8

3 Terms and definitions 8

4 Indication of specifications of low-power smart sensors 8

 4.1 Datasheet description of current consumption – time characteristics 8

 4.2 Datasheet description of information regarding under voltage lock out circuit 10

5 Indication of specifications of power supplies to drive smart sensors 10

Annex A (informative) Practical example of datasheet description of specifications of smart sensors 12

Annex B (informative) Hardware configuration examples of a power supply to drive smart sensor(s) in a smart sensing unit 14

Annex C (informative) Supplementary explanations of various signals among the storage device, the battery and the power generation device 16

Annex D (informative) Practical example of datasheet description of specifications of power supply to drive smart sensor(s) 18

Figure 1 – Block diagram of components in a smart sensing unit 5

Figure 2 – Example of detailed block diagram of a smart sensing unit 6

Figure 3 – Example of datasheet description of current consumption–time characteristics (timing chart) with continuous periodic operations of the low-power smart sensor 9

Figure A.1 – Practical example of datasheet description of specifications of smart accelerometer 13

Figure B.1 – Hardware configuration examples of a power supply to drive smart sensor(s) in a smart sensing unit 15

Figure C.1 – Practical examples of hardware configurations of several signal lines among the storage, the battery and the power generation device 17

Table 1 – Example of datasheet description of current consumption–time characteristics table with continuous periodic operations of the low-power smart sensor 10

Table D.1 – Practical example of datasheet description of specifications of power supply to drive smart sensor(s) 18

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SEMICONDUCTOR DEVICES –

Part 19-2: Smart sensors – Indication of specifications of sensors and power supplies to drive smart sensors for low power operation

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.

IEC TS 60747-19-2 has been prepared by subcommittee 47E: Discrete semiconductor devices, of IEC technical committee 47: Semiconductor devices. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

DTS	Report on voting
47E/693/DTS	47E/742/RVDTS

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 Technical Specification 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/standardsdev/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.

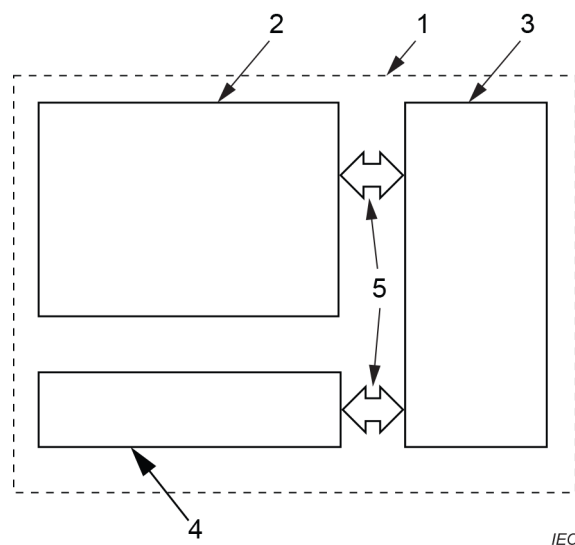
The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

INTRODUCTION

The development of smart sensors which integrate analogue-to-digital conversion and digital processing of the captured sensor signal(s) is in progress. A smart sensing unit, which comprises a smart sensor; a terminal module, to control the smart sensor and perform wireless communication; and a power supply for the smart sensor and the terminal module, can send the output data of the smart sensor wirelessly to the outside. Here, the power supply may be a plug-in power supply, a battery, an energy harvester, or their combination. A smart sensing network where a large number of smart sensing units are located in manufacturing factories, offices, and stores has been examined. With this network, environmental monitoring, sensing operational situations of manufacturing equipment and sensing other various events contribute to the realization of the following outcomes by analysing the collected sensing data. Namely, energy saving, improvement in factory productivity such as operation rate, shortening of production lead time, preventive equipment maintenance, and product quality improvement can be achieved.

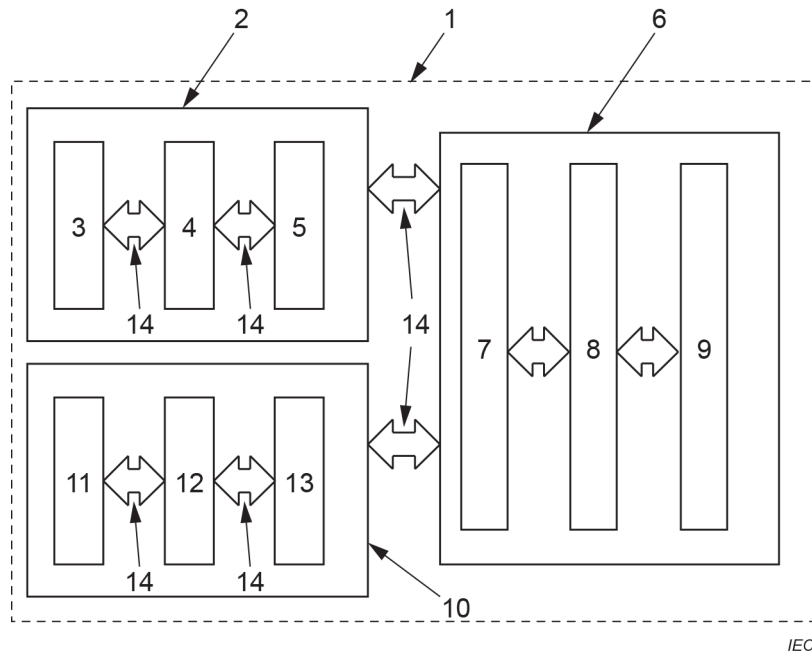
However, as to the three components of the smart sensing unit, namely, smart sensor, terminal module, and power supply, standardization regarding control schemes to connect the components mutually and regarding indication of specifications of the components has not been sufficiently established yet. This issue leads to the present situation, where the development of each component in the smart sensing unit has not proceeded efficiently. (Figure 1 shows the block diagram of the components in the smart sensing unit and Figure 2 shows an example of the detailed block diagram of the smart sensing unit.)



Key:

- 1 smart sensing unit
- 2 smart sensor
- 3 terminal module
- 4 power supply
- 5 electrical connections

Figure 1 – Block diagram of components in a smart sensing unit



Key:

- | | |
|--|-----------------------------------|
| 1 smart sensing unit | 8 data processing circuit |
| 2 smart sensor | 9 wireless communication circuit |
| 3 sensor element | 10 autonomous power supply module |
| 4 analogue-to-digital converting circuit | 11 power generation element |
| 5 digital processing circuit | 12 power storage element |
| 6 terminal module | 13 power management circuit |
| 7 smart sensor control unit | 14 electrical connections |

Figure 2 – Example of detailed block diagram of a smart sensing unit

The IEC 60747-19 series aims to address this issue. The IEC 60747-19 series comprises two parts and its structure is currently conceived as follows:

Part 19-1 – Control scheme of smart sensors

Part 19-2 – Indication of specifications of sensors and power supplies to drive smart sensors for low power operation

Part 19-1 specifies a control scheme of the smart sensor from the terminal module in the smart sensing unit. Generally, the manufacturers of sensors have incorporated into the sensors various parameters and conditions for sensing operations to fulfil various requests and needs of the users. Therefore, it has been quite difficult for the users to understand how to set the parameters and conditions adequately and master the use of sensors. This issue has been a considerable obstacle in designing the smart sensing unit and smart sensing system. The main objective of IEC 60747 Part 19-1 is to solve this obstacle for future expansion of the smart sensors and smart sensing network systems.

This document aims to provide a guideline to indicate information that is required when the smart sensing unit is newly designed. When the smart sensing unit is newly designed especially using an autonomous power supply, the designers have to appropriately arrange selection of the components of the unit and their usage conditions to satisfy that power capability of the power supply successfully exceeds total power budget to be consumed in the unit as a whole. First, information about the detailed power consumption characteristics of the smart sensors is indispensable for this achievement. Namely, information about time-variation power consumption characteristics which is not necessarily described in the datasheet of sensors is essential when intermittent sensing operations are often adopted and a careful lower power design including time-variation characteristics to allow adoption of an autonomous power supply is needed in IoT (Internet of Things) applications. Therefore, this document discusses an indication of smart sensors' time-variation power consumption characteristics. Second, information about total power capability of the power supply to drive the unit and the smart sensor(s) is essential. This power supply as a module comprises (a) primary battery(ies), and(or) (a) secondary battery (ies), and (or) (an) energy harvester(s), or their combinations. To accomplish proper configuration, the information of specifications of power supply is needed. Thus this document also discusses indication of specification of power supply. With the establishments of the appropriate indication, the three components of the smart sensing unit can be easily selected and combined from the point-of-view of a low-power design, when the smart sensing unit is newly designed and the overall design of the smart sensing unit itself can be facilitated. If the telecommunication between smart sensor unit and autonomous power supply unit is done well, the both units work optimally.

Regarding smart sensors, many kinds of operation modes are equipped with the availability of various functions by digital processing. When developing these smart sensors, a careful and precise power consumption design including time-variation characteristics and depending on each operation mode become essential. Therefore, the guideline specified in this document is essential for developing low-power smart sensors and their related devices.

Because the corresponding market has been evolving, and the requirements of the specifications of the components can be slightly changed during this process, guidelines are reported in this document as a Technical Specification (TS) to design the smart sensing unit and its components.

SEMICONDUCTOR DEVICES –

Part 19-2: Smart sensors – Indication of specifications of sensors and power supplies to drive smart sensors for low power operation

1 Scope

This part of IEC 60747 provides a guideline of indication of specifications of a low-power sensor being a device or a module allowing autonomous power supply operation, which contributes to the low-power design of a smart sensing unit. Here, the smart sensing unit comprises a smart sensor, a terminal module, and a power supply, which can send output data of the smart sensor to the outside. This part also provides a guideline of indication of specifications of the power supply to drive the smart sensor(s) in the smart sensing unit. Based on these, the three components of the smart sensing unit can be easily selected and combined from the point-of-view of newly designed, low-power, smart sensing units.

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.

There are no normative references in this document.

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

autonomous power supply

standalone power supply with batteries and (or) energy harvesters obtaining energy from the so-called ambient energy sources, such as light, vibration, thermal, or biological sources

4 Indication of specifications of low-power smart sensors

4.1 Datasheet description of current consumption – time characteristics

In order to realize a low-power smart sensor allowing an autonomous power supply operation that is the target of this document, clarifying power consumption characteristics of the smart sensor to its users is significant. Therefore, its current consumption-time characteristics and information regarding its operation conditions should be described in the datasheet of the smart sensor.