

# INTERNATIONAL STANDARD

**Fibre optic active components and devices – Package and interface standards –  
Part 21: Design guidelines of electrical interface of PIC packages using silicon  
fine-pitch ball grid array (S-FBGA) and silicon fine-pitch land grid array  
(S-FLGA)**

IECNORM.COM : Click to view the full PDF of IEC 62148-21:2021



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2021 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 It also gives information on projects, replaced and withdrawn publications.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).

**IEC online collection - [oc.iec.ch](http://oc.iec.ch)**

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

**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 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IECNORM.COM : Click to view the full PDF of IEC 60214-8-2:2021

# INTERNATIONAL STANDARD

---

**Fibre optic active components and devices – Package and interface standards –  
Part 21: Design guidelines of electrical interface of PIC packages using silicon  
fine-pitch ball grid array (S-FBGA) and silicon fine-pitch land grid array  
(S-FLGA)**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 33.180.20

ISBN 978-2-8322-9723-0

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

## CONTENTS

|   |    |
|---|----|
| FOREWORD .....  | 3  |
| 1 Scope .....   | 5  |
| 2 Normative references .....  | 5  |
| 3 Terms and definitions .....   | 5  |
| 4 Terminal position numbering .....   | 6  |
| 5 Code of package nominal dimensions .....  | 6  |
| 6 Symbols and drawings .....  | 6  |
| 7 Dimensions and tolerances .....   | 8  |
| Bibliography .....  | 13 |
| Figure 1 – S-FBGA and S-FLGA outline .....  | 7  |
| Figure 2 – Mechanical gauge drawing .....   | 8  |
| Figure 3 – Array of terminal-existence areas .....  | 8  |
| Table 1 – Dimensions and tolerances .....   | 9  |
| Table 2 – Combination list of $D$ , $E$ , $M_D$ , and $M_E$ for $e = 0,30$ mm pitch S-FBGA<br>(informative) ..... | 11 |
| Table 3 – Combination list of $D$ , $E$ , $M_D$ , and $M_E$ for $e = 0,25$ mm pitch S-FLGA .....                  | 12 |

IECNORM.COM : Click to view the full PDF of IEC 62148-21:2021

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES –  
PACKAGE AND INTERFACE STANDARDS –****Part 21: Design guidelines of electrical interface of PIC  
packages using silicon fine-pitch ball grid array (S-FBGA)  
and silicon fine-pitch land grid array (S-FLGA)**

## 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 62148-21 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This second edition cancels and replaces the first edition published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical change with respect to the previous edition: specification of an electric guard band area around the optical terminal area, so as to allow applications with electric signals at higher symbol rates (e.g. 50 Gbaud and 100 Gbaud).

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

| CDV          | Report on voting |
|--------------|------------------|
| 86C/1684/CDV | 86C/1710/RVC     |

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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

A list of all parts in the IEC 62148 series, published under the general title *Fibre optic active components and devices – Package and interface standards*, 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](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.

IECNORM.COM : Click to view the full PDF of IEC 62148-21:2021

## FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PACKAGE AND INTERFACE STANDARDS –

### Part 21: Design guidelines of electrical interface of PIC packages using silicon fine-pitch ball grid array (S-FBGA) and silicon fine-pitch land grid array (S-FLGA)

#### 1 Scope

This part of IEC 62148 covers the design guidelines of the electrical interface for photonic integrated circuit (PIC) packages using silicon fine-pitch ball grid array (S-FBGA) and silicon fine-pitch land grid array (S-FLGA). In this document, the electrical interface for the S-FBGA package is informative.

The purpose of this document is to specify adequately the electrical interface of PIC packages composed of optical transmitters and receivers that enable mechanical and electrical interchangeability of PIC packages.

#### 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 60050-731, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication* (available at [www.electropedia.org](http://www.electropedia.org))

IEC TR 61931, *Fibre optic – Terminology*

#### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-731, IEC TR 61931 and the following 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

##### **silicon fine-pitch ball grid array**

##### **S-FBGA**

device composed of silicon die, dielectric layer(s) on the die, rerouting wires from the die pads to outer balls on the dielectric layer(s), and outer balls with heights more than 0,1 mm

##### 3.2

##### **silicon fine-pitch land grid array**

##### **S-FLGA**

device composed of silicon die, dielectric layer(s) on the die, rerouting wires from the die pads to outer lands on the dielectric layer(s), and outer lands with heights of 0,1 mm or less

#### 4 Terminal position numbering

When a package is viewed from the terminal side with the index corner in the bottom left corner position, terminal rows are lettered from bottom to top starting with A, then B, C..., AA, AB, etc.; whereas terminal columns are numbered from left to right starting with 1. Terminal positions are designated by a row-column grid system and shown as alphanumeric identification, for example A1, B1. The letters I, O, Q, S, X and Z shall not be used for naming the terminal rows.

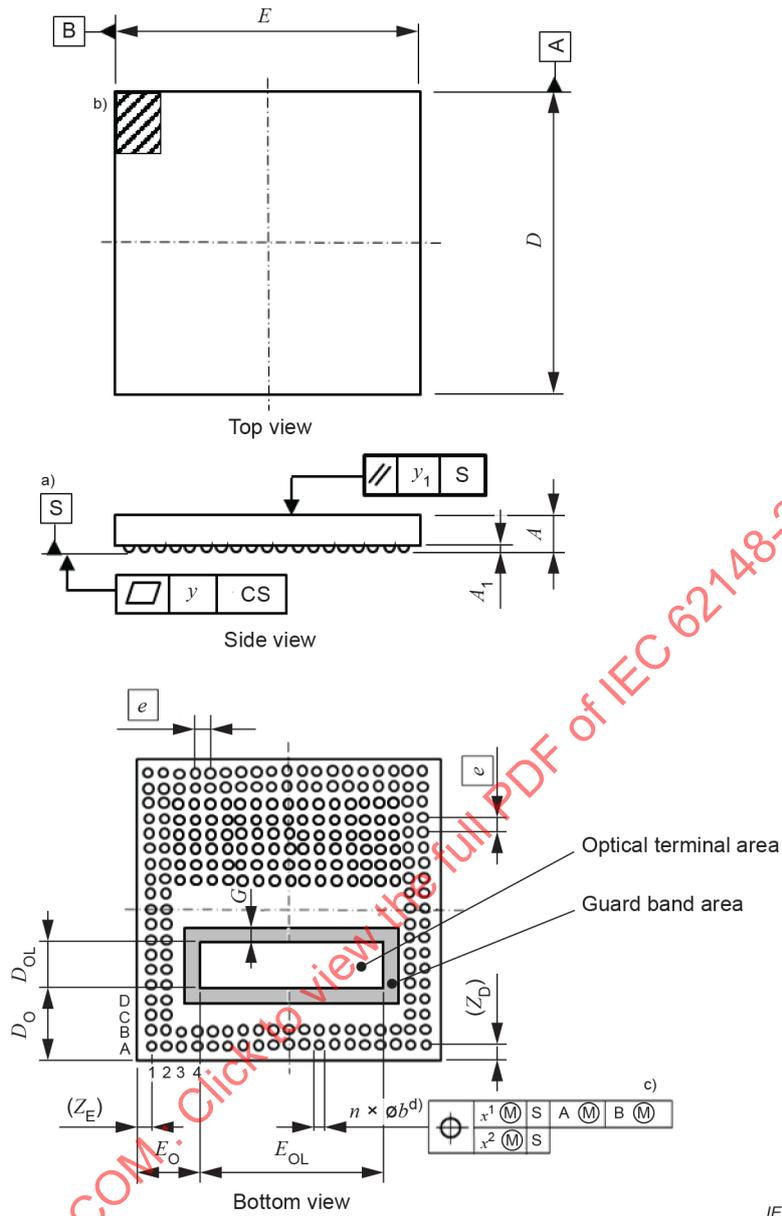
#### 5 Code of package nominal dimensions

A code of package nominal dimensions is defined as the combination of package length  $E$  and width  $D$ , which are shown to the second decimal place in millimetres.

#### 6 Symbols and drawings

Figure 1 shows the dimensions of the package and the outline of the electrical interface for S-FBGA and S-FLGA. Figure 1 also shows the dimensions of the optical terminal area and its guard band area. The electrical terminal is freely allocated to the terminal positions defined by the cross points of the row-column grid numbers, as long as its position is outside of the optical terminal guard band area. The optical interface shall be designed within the optical terminal area. Figure 2 and Figure 3 indicate the mechanical gauge drawing and its array of electrical terminal existence area. Figure 2 shows the electrical terminal existing area referred to data S, A and B. Figure 3 shows the electrical terminal existing area referred to datum S.

IECNORM.COM : Click to view the full PDF of IEC 62148-21:2021

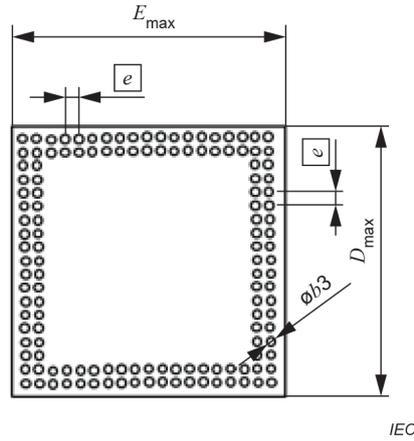


IEC

NOTE The letter symbols used in the figure are listed and described in Table 1.

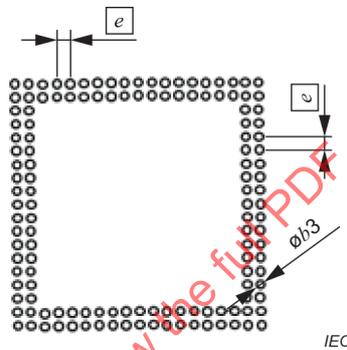
- a Datum S is the seating plane on which a package stays.
- b The hatched zone is an index-marking area indicating A1 corner.
- c True positional tolerances of terminals  $x_1$  and  $x_2$  are applied to all terminals.
- d The terminal diameter  $b$  is the maximum diameter of the ball as measured in a plane parallel to the seating plane.

**Figure 1 – S-FBGA and S-FLGA outline**



NOTE The letter symbols used in the figure are listed and described in Table 1.

**Figure 2 – Mechanical gauge drawing**



NOTE The letter symbols used in the figure are listed and described in Table 1.

**Figure 3 – Array of terminal-existence areas**

## 7 Dimensions and tolerances

Table 1 specifies the tolerance of each symbol parameter; Table 2 and Table 3 indicate the options of  $D$ ,  $E$ ,  $M_D$  and  $M_E$ .

Table 1 – Dimensions and tolerances

| Term  | Symbol       | Specification   | Recommended value | Notes   |
|---|--------------|---|-------------------|---|
| Code of package nominal dimensions            | $D \times E$ | Code of package nominal dimension is defined as the combination of package width $D$ and package length $E$ , which are shown in the second decimal place                                 | -                 | -   |
| Package width                                 | $D$          | Package width is shown in the second decimal place<br>Package width $D_{nom}$<br>Minimum 0,50<br>Maximum 10,00<br>Tolerance $V_D$ $\pm 0,05$  |                   | $V_D$ denotes tolerance.                          |
| Package length                                | $E$          | Package length is shown in the second decimal place<br>Package length $E_{nom}$<br>Minimum 0,50<br>Maximum 10,00<br>Tolerance $V_E$ $\pm 0,05$  |                   | $V_E$ denotes tolerance                           |
| Profile height                                | $A$          | When $A$ is $\leq 0,65$ , the tolerance of nominal height is $\pm 0,07$ .<br>When $0,8 \leq A \leq 1,0$ , the tolerance of nominal height is $\pm 0,10$ .<br>$A$ shall not exceed 1,0.    |                   | $A$ includes package warpage and tilt allowances. |
| Stand-off height                              | $A1$         | 1) For S-FBGA (informative)<br>$e: 0,3$ $b_{nom}: 0,2$<br>min. 0,1<br>nom. 0,15<br>max. 0,2<br>For low stand-off S-FBGA<br>$A1 \leq 0,20$<br>2) For S-FLGA<br>$e: 0,25$<br>$A1 \leq 0,10$ |                   |   |
| Terminal pitch                                | $e$          | 1) For S-FBGA (informative)<br>0,3<br>2) For S-FLGA<br>0,25   |                   |   |
| Terminal diameter                             | $b$          | 1) For S-FBGA (informative)<br>$e: 0,3$<br>min. 0,17<br>nom. 0,20<br>max. 0,23<br>2) For S-FLGA<br>$e: 0,25$<br>min. 0,10<br>nom. 0,13<br>max. 0,16                                       |                   |   |
| Datum-based positional tolerance of terminals | $x1$         | $x1 = 0,08$   |                   |   |

| Term  | Symbol   | Specification   | Recommended value | Notes  |
|---|----------|---|-------------------|--|
| Relative positional tolerance of terminals                      | $x_2$    | 1) For S-FBGA (informative)<br>$e: 0,3 \quad x_2 = 0,03$<br>2) For S-FLGA<br>$e: 0,25 \quad x_2 = 0,03$ |                   |  |
| Coplanarity   | $y$      | 1) For S-FBGA (informative)<br>$e: 0,3 \quad y = 0,05$<br>2) For S-FLGA<br>$e: 0,25 \quad y = 0,05$     |                   |  |
| Parallelism of the top surface                                  | $y_1$    | $y_1 = 0,08$  |                   |  |
| Number of terminals   | $n$      | $n = M_D \times M_E$  |                   | Numbers of matrices in $M_E$ and $M_D$ are shown in Table 3. |
| Maximum matrix size in length                                   | $M_E$    | $(M_D - 1) \times M_E$  |                   |  |
| Maximum matrix size in width                                    | $M_D$    | $M_D \times (M_E - 1)$<br>$(M_D - 1) \times (M_E - 1)$  |                   |  |
|   |          | $M_E \leq (E - b_{\max} - V_E - x_1 - x_2)/e + 1$<br>$M_D \leq (D - b_{\max} - V_D - x_1 - x_2)/e + 1$  |                   |  |
| Overhang dimension in width                                     | $Z_D$    | $Z_D = [D_{\text{nom}} - (M_D - 1) \times e] / 2$   | -                 | Reference value  |
| Overhang dimension in length                                    | $Z_E$    | $Z_E = [E_{\text{nom}} - (M_E - 1) \times e] / 2$   | -                 | Reference value  |
| Datum-defined terminal existence area                           | $b_3$    | $b_3 = b_{\max} + x_1$  |                   |  |
| Relative terminal existence area                                | $b_4$    | $b_4 = b_{\max} + x_2$  |                   |  |
| Relative optical terminal area datum position along with width  | $D_O$    | Design value  |                   |  |
| Width of optical terminal area                                  | $D_{OL}$ | Design value  |                   |  |
| Relative optical terminal area datum position along with length | $E_O$    | Design value  |                   |  |
| Length of optical terminal area                                 | $E_{OL}$ | Design value  |                   |  |
| Guard band length   | $G$      | Design value  |                   |  |
| NOTE Dimensions are in millimetres.                             |          |   |                   |  |

**Table 2 – Combination list of  $D$ ,  $E$ ,  $M_D$ , and  $M_E$  for  $e = 0,30$  mm pitch S-FBGA (informative)**

| <b>BGA <math>b_{\max} = 0,23</math></b> |                |                        |
|---|----------------|------------------------|
| $D$ or $E$<br>mm                        | $M_D$ or $M_E$ | $M_D - 1$ or $M_E - 1$ |
| 0,69 to 0,98                            | 2              | -                      |
| 0,99 to 1,28                            | 3              | 2                      |
| 1,29 to 1,58                            | 4              | 3                      |
| 1,59 to 1,88                            | 5              | 4                      |
| 1,89 to 2,18                            | 6              | 5                      |
| 2,19 to 2,48                            | 7              | 6                      |
| 2,49 to 2,78                            | 8              | 7                      |
| 2,79 to 3,08                            | 9              | 8                      |
| 3,09 to 3,38                            | 10             | 9                      |
| 3,39 to 3,68                            | 11             | 10                     |
| 3,69 to 3,98                            | 12             | 11                     |
| 3,99 to 4,28                            | 13             | 12                     |
| 4,29 to 4,58                            | 14             | 13                     |
| 4,59 to 4,88                            | 15             | 14                     |
| 4,89 to 5,18                            | 16             | 15                     |
| 5,19 to 5,48                            | 17             | 16                     |
| 5,49 to 5,78                            | 18             | 17                     |
| 5,79 to 6,08                            | 19             | 18                     |
| 6,09 to 6,38                            | 20             | 19                     |
| 6,39 to 6,68                            | 21             | 20                     |
| 6,69 to 6,98                            | 22             | 21                     |
| 6,99 to 7,28                            | 23             | 22                     |
| 7,29 to 7,58                            | 24             | 23                     |
| 7,59 to 7,88                            | 25             | 24                     |
| 7,89 to 8,18                            | 26             | 25                     |
| 8,19 to 8,48                            | 27             | 26                     |
| 8,49 to 8,78                            | 28             | 27                     |
| 8,79 to 9,08                            | 29             | 28                     |
| 9,09 to 9,38                            | 30             | 29                     |
| 9,39 to 9,68                            | 31             | 30                     |
| 9,69 to 9,98                            | 32             | 31                     |
| 9,99 to 10,28                           | 33             | 32                     |

**Table 3 – Combination list of  $D$ ,  $E$ ,  $M_D$ , and  $M_E$  for  $e = 0,25$  mm pitch S-FLGA**

| $D$ or $E$<br>mm | $M_D$ or $M_E$ | $M_D - 1$ or<br>$M_E - 1$ | $D$ or $E$<br>mm | $M_D$ or $M_E$ | $M_D - 1$ or<br>$M_E - 1$ |
|------------------|----------------|---------------------------|------------------|----------------|---------------------------|
| 0,57 to 0,81     | 2              | -                         | 5,32 to 5,56     | 21             | 20                        |
| 0,82 to 1,06     | 3              | 2                         | 5,57 to 5,81     | 22             | 21                        |
| 1,07 to 1,31     | 4              | 3                         | 5,82 to 6,06     | 23             | 22                        |
| 1,32 to 1,56     | 5              | 4                         | 6,07 to 6,31     | 24             | 23                        |
| 1,57 to 1,81     | 6              | 5                         | 6,32 to 6,56     | 25             | 24                        |
| 1,82 to 2,06     | 7              | 6                         | 6,57 to 6,81     | 26             | 25                        |
| 2,07 to 2,31     | 8              | 7                         | 6,82 to 7,06     | 27             | 26                        |
| 2,32 to 2,56     | 9              | 8                         | 7,07 to 7,31     | 28             | 27                        |
| 2,57 to 2,81     | 10             | 9                         | 7,32 to 7,56     | 29             | 28                        |
| 2,82 to 3,06     | 11             | 10                        | 7,57 to 7,81     | 30             | 29                        |
| 3,07 to 3,31     | 12             | 11                        | 7,82 to 8,06     | 31             | 30                        |
| 3,32 to 3,56     | 13             | 12                        | 8,07 to 8,31     | 32             | 31                        |
| 3,57 to 3,81     | 14             | 13                        | 8,32 to 8,56     | 33             | 32                        |
| 3,82 to 4,06     | 15             | 14                        | 8,57 to 8,81     | 34             | 33                        |
| 4,07 to 4,31     | 16             | 15                        | 8,82 to 9,06     | 35             | 34                        |
| 4,32 to 4,56     | 17             | 16                        | 9,07 to 9,31     | 36             | 35                        |
| 4,57 to 4,81     | 18             | 17                        | 9,32 to 9,56     | 37             | 36                        |
| 4,82 to 5,06     | 19             | 18                        | 9,57 to 9,81     | 38             | 37                        |
| 5,07 to 5,31     | 20             | 19                        | 9,82 to 10,06    | 39             | 38                        |

IECNORM.COM : Click to view the full PDF of IEC 62148-21:2021