

# **JEDEC STANDARD**

---

## **Procurement Standard for Semiconductor Die Products Including Known Good Die (KGD)**

---

### **JESD49B**

(Revision of JESD49A.01, October 2013)

**DECEMBER 2020**

---

**JEDEC SOLID STATE TECHNOLOGY ASSOCIATION**



## NOTICE

JEDEC standards and publications contain material that has been prepared, reviewed, and approved through the JEDEC Board of Directors level and subsequently reviewed and approved by the JEDEC legal counsel.

JEDEC standards and publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for use by those other than JEDEC members, whether the standard is to be used either domestically or internationally.

JEDEC standards and publications are adopted without regard to whether or not their adoption may involve patents or articles, materials, or processes. By such action JEDEC does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the JEDEC standards or publications.

The information included in JEDEC standards and publications represents a sound approach to product specification and application, principally from the solid state device manufacturer viewpoint. Within the JEDEC organization there are procedures whereby a JEDEC standard or publication may be further processed and ultimately become an ANSI standard.

No claims to be in conformance with this standard may be made unless all requirements stated in the standard are met.

Inquiries, comments, and suggestions relative to the content of this JEDEC standard or publication should be addressed to JEDEC at the address below, or refer to [www.jedec.org](http://www.jedec.org) under Standards and Documents for alternative contact information.

Published by  
©JEDEC Solid State Technology Association 2020  
3103 North 10th Street  
Suite 240 South  
Arlington, VA 22201-2107

This document may be downloaded free of charge; however JEDEC retains the copyright on this material. By downloading this file the individual agrees not to charge for or resell the resulting material.

**PRICE: Contact JEDEC**

Printed in the U.S.A.  
All rights reserved

PLEASE!

DON'T VIOLATE  
THE  
LAW!

This document is copyrighted by JEDEC and may not be  
reproduced without permission.

For information, contact:

JEDEC Solid State Technology Association  
3103 North 10th Street  
Suite 240 South  
Arlington, VA 22201-2107

or refer to [www.jedec.org](http://www.jedec.org) under Standards-Documents/Copyright Information.



**PROCUREMENT STANDARD FOR SEMICONDUCTOR DIE PRODUCTS  
INCLUDING KNOWN GOOD DIE (KGD)**

**CONTENTS**

---

	<b>Page</b>
Foreword	ii
1 Scope	1
2 Reference Documents	1
3 Requirements	3
4 Suggested Additional Information	9
Annex A Standard Die Products Requirements	11
Annex B Differences between Revisions	12

## **PROCUREMENT STANDARD FOR SEMICONDUCTOR DIE PRODUCTS INCLUDING KNOWN GOOD DIE (KGD)**

---

### **Foreword**

---

This standard was created to facilitate the procurement and use of semiconductor die products provided in bare or bumped die form. This document provides requirements and guidance to die suppliers in regard to the levels of as-delivered performance, quality and reliability expected of this product type. It also reflects the special needs of die product customers in terms of design and application data. This document is applicable to die products used in both commercial and military applications.

This standard also reflects an understanding on the part of the die product user that quality and reliability cannot always be assured in the same fashion as for conventionally packaged microcircuits. Die product customers take on a significant responsibility for the proper application and long-term environmental protection of this type of product. The extent to which a supplier shall assure die products is highly dependent upon the customer's capability and adherence to strict quality controls. Cooperation between suppliers and users is essential.

## PROCUREMENT STANDARD FOR SEMICONDUCTOR DIE PRODUCTS INCLUDING KNOWN GOOD DIE (KGD)

(From JEDEC Board Ballot JCB-20-12, formulated under the cognizance of the JC-13 Committee on Government Liaison.)

---

### 1 Scope

---

This standard provides guidelines and requirements for die products used in other than conventionally packaged microcircuit or discrete formats. The die described herein are intended to be high quality, reliable bare die, for use in a variety of user-defined applications (e.g., multi-chip modules (MCM), System in a Package (SiP), memory cards, etc.) While this standard allows negotiation between supplier and user to establish specific requirements for performance, quality and reliability, it is important to recognize, in the case of military and aerospace applications, the minimum requirements described in relevant military specifications.

This standard is limited to die products consisting of a single microcircuit or discrete device connected using conventional wire bonding or High Density Interconnect. KGD products are intended to be equivalent to or better than comparable packaged parts in terms of electrical and reliability performance (unless specifically noted by the supplier). Per requirements mutually agreed upon by the KGD supplier and user, the KGD supplier shall implement and demonstrate testing and screening required to assure this performance.

This standard deals only with die products supplied in individual die form, for which the user accepts responsibility for providing and assuring final environmental protection (e.g., hermetic sealing, plastic encapsulation).

---

### 2 Reference documents

---

#### 2.1 Military and Federal Standards<sup>1</sup>

MIL-STD-883, *Microelectronics, Test Methods, and Procedures*

MIL-PRF-19500, *General Specification for Semiconductor Devices*

MIL-PRF-38534, *General Specification for Hybrid Microcircuits*

MIL-PRF-38535, *General Specification for Integrated Circuits Manufacturing*

---

<sup>1</sup> Available from Defense Logistics Agency - <https://landandmaritimeapps.dla.mil/Downloads/MilSpec/Docs>

## **2 Reference documents (cont'd)**

### **2.2 Institute of Electrical and Electronics Engineers Standards<sup>2</sup>**

IEEE 1029.1, *Waveform and Vector Exchange Specification*

IEEE 1076, *VHSIC Hardware Description Language*

IEEE/ANSI 1149.1, *Standard Test Access Port and Boundary-Scan Architecture*

### **2.3 JEDEC Standards<sup>3</sup>**

JESD16, *Assessment of Microcircuit Outgoing Nonconforming Levels in Parts Per Million (PPM)*

J-STD-046, *Guidelines for User Notification of Process Changes by Semiconductor Suppliers*

EIA557, *Statistical Process Control Systems*

EIA599, *National Electronic Process Certification Standard*

JESD625, *Requirements for Handling Electrostatic Discharge (ESDS) Sensitive Devices*

JEP160, *Long Term Storage for Electronics Solid-State Wafers, Dice, and Devices*

### **2.4 International Standards<sup>4</sup>**

ISO 9001, *Quality Management Standard*

ISO 14644, *Clean Rooms and Associated Controlled Environments*

ISO/TS 19649, *Automotive Production Quality Management*

### **2.5 Other Reference Documents**

Relevant Die Supplier Data Book/Sheet or Specification

### **2.6 Order of Precedence**

In the case of conflict between/among applicable specifications:

- a) Purchase order or other contractual documents
- b) Detailed specifications
- c) Other mutually agreed documents
- d) This standard

---

<sup>2</sup> Available from Institute of Electrical and Electronics Engineers, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331

<sup>3</sup> Available from JEDEC, 2500 Wilson Blvd., Arlington, VA 22201-3834

<sup>4</sup> Available from ISO, 3 rue de Varembe, CH-1211 Geneva 20, Switzerland



---

## **3 Requirements**

---

### **3.1 Overview**

In addition to the information provided elsewhere for the equivalent standard packaged device, KGD suppliers shall provide data as required in sections 3.2 to 3.9. Standard die product requirements are listed in Annex A. For military and aerospace applications, additional requirements are defined in the appropriate military specifications.

### **3.2 General Data**

The following general data shall be provided for KGD products and standard die products if required in Annex A.

#### **3.2.1 Part Numbering**

Each die supplier shall establish a specific part numbering system that differentiates its die products from each other and from conventionally packaged equivalents.

#### **3.2.2 Product Status**

The supplier shall make available, information regarding the availability and status of the die product (e.g. impending die shrink, end of life).

#### **3.2.3 Sample Die**

Die users may require four types of sample die. Availability of these sample types and the quantities to be provided shall be negotiated as part of appropriate contractual agreements. These types include:

- a) Conventionally packaged equivalents for system prototype.
- b) Mechanical samples of identical physical layout orientation and pad metallurgy to the final die product and clearly identified as "reject".
- c) Prototype (proof of design) samples that are electrically functional and from product representative of the die product to be sold to a particular customer.
- d) Acceptance samples that are representative of the updated version of a die type that is about to be released with design or manufacturing changes. These samples are intended to afford existing customers of this die product an opportunity to evaluate the impact of these changes upon their specific application.

### **3 Requirements (cont'd)**

#### **3.3 Mechanical Data**

Mechanical data specifically required for the application of die products shall be provided. The data shall be provided in a format established by each supplier. Custom data and formats may be available as negotiated in contractual agreements. The data to be provided are as follows.

##### **3.3.1 Bond pad map**

Bond pad map (including available bonding area / glassivation opening size), pin-out list, including electrical function and pin number one identification with appropriate test designator.

##### **3.3.2 Identification of connections**

Identification of any connections that must be jumpered or skipped (e.g., test pads) including any substrate connection requirements. It shall be made clear whether a substrate connection is required, optional or not recommended.

##### **3.3.3 Coordinates of a reference position**

The coordinates of a reference position on the die with respect to the geometric center or corner of the die surface shall be given. This forms the origin of the coordinate system with respect to which the position of die features, such as pad positions, are referenced.

##### **3.3.4 Length and width**

The maximum length and width of the die:

a) for bare die these are the maximum dimensions after sawing

NOTE If these are not available, the scribe street center to scribe street center dimensions shall be given.

b) for wafers these are the scribe street center to scribe street center

##### **3.3.5 Thickness**

The maximum thickness of the finished die.

### **3.3 Mechanical data (cont'd)**

#### **3.3.6 Dimensional tolerance**

Dimension tolerances for die size, die thickness, pad dimensions and pad positions.

#### **3.3.7 Backside material**

Type of backside surface material and surface finish (e.g., polished or lapped)

#### **3.3.8 Topside material**

Final die glassivation (top protective layer) material.

#### **3.3.9 Bond pad composition**

Top-level pad metal composition

#### **3.3.10 Backside potential**

Electrical potential of die bottom surface (e.g., floating,  $V_{cc}$ , ground), maximum bias voltage.

#### **3.3.11 Operating temperature range**

The operating temperature range of the die over which the device will operate in accordance with its published specifications.

#### **3.3.12 Process limitations**

Known process limitations (e.g., maximum processing temperatures, pressure sensitivity, UV light sensitivity, etc).

#### **3.3.13 Special considerations**

Other conditions that affect die function, such as critical thermal environments, or additional materials (e.g., die attach materials) or components normally connected to or used within the packaged part (e.g., trimming capacitors).

#### **3.3.14 Power applications**

In high power applications, minimum current carrying requirement for the user's substrate.

### **3 Requirements (cont'd)**

#### **3.4 Electrical data**

The die supplier shall provide, if applicable, and as negotiated in contractual agreements, the following electrical test data for each die product type. Nondisclosure agreements may be required prior to release of some of these data.

- a) Designed-in testability features (e.g., redundancy, control fuses, error correction, ad hoc, structured, boundary scan, built-in self test, etc.) with a full description and explanation of each.
- b) Device Boundary Scan Description Language (BSDL) model in cases where IEEE 1149.1 boundary-scan is implemented (Ref IEEE/ANSI 1149.1-1990).
- c) Any other product specific information relevant to electrical testing (e.g. special test strategy or voltage stress to achieve quality goals).
- d) Exceptions to supplier's packaged device data book.
- e) VHDL models.

#### **3.5 Quality provisions**

##### **3.5.1 Quality assurance provisions**

Die suppliers shall be prepared to demonstrate, with data or other certification, one or more of the quality assurance provisions described below. Nondisclosure agreements may be required prior to release of some data.

- MIL-PRF-38535 QML certification or equivalent.
- Compliance with MIL-STD-883.
- QMS registered to ISO 9001 or ISO/TS 19649
- Compliance with EIA557
- Supplier specific internal quality control methods.

##### **3.5.2 Quality Performance Provisions**

The die supplier shall state a quality estimate for the die product. One or more of the following provisions shall be utilized.

- Equivalent to package device.
- Outgoing die product DPM (Defects Per Million) due to all causes. (e.g., electrical reference to data sheet, visual, and mechanical) per JESD16.
- 100% electrically tested to supplier and user agreed upon specifications.
- Visual/Mechanical inspection to supplier and user agreed upon specification.
- Supplier specific internal processing flow.

### **3 Requirements (cont'd)**

#### **3.6 Reliability**

The die supplier shall state a reliability estimate for the die product type. One or more of the following reliability metrics shall be utilized. Nondisclosure agreements may be required prior to release of some data.

NOTE Final module reliability is a combination of the individual die type reliability, quantity of die in the module, substrate signal routing, thermal dissipation properties and many other variables. Any reliability data so provided by the manufacturer or supplier shall be treated as only for an individual die device type, and only as “*as received*”, not “*as assembled*”.

- “Infant mortality” data or Percent Defective Allowable (PDA) for burned-in die.
- Supplier life test data based on comparable packaged parts.
- Other company approaches (e.g., statistical process controls, in line/end of line monitors, tests and screens, etc.)
- 100% stress testing (e.g., burn-in, temp cycle, electrical stress) to supplier specifications.

#### **3.7 Change Notification**

Die product suppliers shall provide notification of the types of changes as specified below. The supplier shall establish their change notification system using this standard as a guide. For die defined as compliant to military or industry documents, change notification shall be in accordance with the requirements defined therein.

- a) Degradations in die quality or reliability or unanticipated changes in quality assurance provisions for as delivered product.
- b) Changes to die size, thickness, and size/location of contact pads, passivation, bond pad opening or metallization.
- c) Changes to the die electrical data.
- d) Changes to mechanical handling requirements.
- e) Changes to requirements for transportation protection, shipping, and storage.
- f) Anticipated changes in die reliability, quality, or quality assurance provisions.
- g) Discontinuation of die type.

#### **3.8 Packing and shipping**

Die product suppliers shall pack and ship the die product as follows:

- a) Die shall be packed and shipped in a method suitable to ensure protection from mechanical damage, electrostatic discharge, and contamination while allowing recovery of die. Special packing and shipping considerations may be included in contractual agreements.

### **3.8 Packing and shipping (cont'd)**

- b) The die supplier shall provide a method for coding and maintaining traceability for each die to its lot number, and shall maintain traceability data for a minimum period of five years, or as required by the procurement document. The die user accepts responsibility for maintaining end item packaged die traceability to the suppliers lot number.
- c) As a minimum, each shipment of die products shall include the following information:
  - Generic die type and revision number.
  - Manufacturer of the die product.
  - Name of the supplier.
  - Traceable lot number.
  - Any other coding necessary to link the die product to proper corresponding documentation.
  - Assured speed grade of the die product (when specified).
  - Quantity of die products in the shipment.
  - Product specific information (e.g., ESD, sensitivity to light, atmosphere required upon opening, etc.).
  - Shipping date.
  - Wafer number (when required per the contractual agreement).

### **3.9 Storage requirements**

Please refer to JEP160 for long-term storage general guidelines. For die products, the supplier shall identify deviations and the reason for deviation from the following storage conditions:

#### **3.9.1 Materials**

- a) ESD protective per JESD625.
- b) Non-outgassing, chemically stable.

#### **3.9.2 Storage in cabinets**

- a) Atmosphere: Inert gas, dry air or dry nitrogen.
- b) Temperature range: 18+/- 3 °C (65 to 75 °F)
- c) Humidity range: <30%
- d) Particle count: Class 6 per ISO 14644

#### **3.9.3 Storage in containers (not cabinets)**

Vacuum sealed or backfilled with inert gas

---

#### **4 Suggested additional information**

---

The supplier may provide, as negotiated, the following data, if available, for information purposes. Nondisclosure agreements may be required prior to release of some information.

- Suggested die attach material and properties.
- Suggested bond wire size and down bonds (pad number and electrical potential).
- Suggested bonding method (e.g., thermocompression, thermosonic, etc.).
- Descriptions of any other unique materials or exposed surfaces that may require special protection during assembly.
- Suggested limitations on handling methods, or die attach pressures.
- Suggested wire bonding sequence, quantity of bond wires on power and ground pins, and stitch-bond (connection) requirements between ground pins.
- Suggested lid sealing material and sealing procedure.
- Packaged component ESD sensitivity.
- Environmental conditions necessary to ensure long term die reliability (e.g., special sealing atmosphere).
- Die power dissipation data or models as a function of frequency, junction temperature, loading, and location on die surface.
- Electrical test fault coverage and grader used, as well as test patterns in WAVES (Waveform and Vector Exchange Specification, IEEE 1029. 1) format or equivalent.
- Die driver and I/O buffer models and data in Berkeley SPICE or equivalent.
- Die structural or behavioral models and data in VHSIC Hardware Descriptive Language (Ref IEEE 1076-) or equivalent.
- I/O pins drive strength / voltage options.
- Soft error rates.
- Maximum steady state current for each supply voltage.
- Maximum transient current spike expected during operation, programming or test for each supply voltage.
- Identify and function of pads used at wafer test but not at package test.
- Identification of parameters actually tested versus verification by other means (e.g., characterization, correlation, inference).
- Maximum recommended allowable peak die assembly process temperatures/times.
- $T_J$  to  $T_{\text{Die Backside}}$  relationship.

#### **4 Suggested additional information (cont'd)**

- Dimensional data (for features of top metal and glassivation mask layers) in a mutually agreed upon format.
- Backside surface roughness, finish type, etc.
- Environmental conditions and storage duration prior to shipment.
- Saw kerf shape.
- Unusual die material properties (e.g., SiC backside coatings, low K dielectrics).
- Moisture resistance data (for nonhermetic applications) based upon accelerated stress studies (e.g., 85% RH-85 °C, Highly Accelerated Stress Testing, Autoclave, etc.) of existing nonhermetic packaged product.
- Recommended die coat material, thickness, and application process as required.
- Redundancy repair or programmable control fuse features, e.g., timers.
- Maximum allowable die / wafer thinning.



---

**Annex A Standard Die Products Requirements**

---

The following paragraphs from the body of the standard shall apply to standard die products.

- 3.2.1 Part numbering
- 3.2.2 Product status
- 3.3.1 Bond pad map
- 3.3.2 Identification of connections
- 3.3.4 Length and width
- 3.3.5 Thickness
- 3.3.6 Dimensional tolerance
- 3.3.7 Backside material
- 3.3.10 Backside potential
- 3.3.11 Operating temperature range
- 3.4e Exceptions to supplier's packaged device data book
- 3.5.1 Quality assurance provisions, including subparagraphs
- 3.7 Change notification
- 3.8 Packing and shipping
- 3.9 Storage requirements, including subparagraphs

---

**Annex B (informative) Differences between revisions**

---

This annex briefly describes most of the changes made to entries that appear in this standard. Some editorial changes that simply involves any words added or deleted or punctuations may be not included.

**B.1 Differences between JESD49B compared to JESD49A.01 (October 2013)**

<b>Clause</b>	<b>Description of change</b>
All	Remove specific dates on some references (year 2000 from ISO 9001 and year 1987 from IEEE 1076)
2	Updated References to EIA and JEDEC documents; Added JEP160 and ISO/TS 19649
6.3.5.2	Updated reference to JESD16 only
3.7	Replace glassivation with passivation
3.9	Added JEP160 for general guidelines on long term storage

**B.2 Differences between JESD49A.01, compared to its predecessor, JESD49A (September 2005, Reaffirmed 2009)**

<b>Clause</b>	<b>Description of change</b>
All	Minor format changes to bring up to date with current formatting practices.
2	Updated References to JEDEC documents; removed 2.4, Electronic Industries Standards, the documents referenced were moved to 2.3 under JEDEC



---

**Standard Improvement Form****JEDEC JESD49B**

---

The purpose of this form is to provide the Technical Committees of JEDEC with input from the industry regarding usage of the subject standard. Individuals or companies are invited to submit comments to JEDEC. All comments will be collected and dispersed to the appropriate committee(s).

If you can provide input, please complete this form and return to:

JEDEC  
Attn: Publications Department  
3103 North 10<sup>th</sup> Street. Suite 240S  
Arlington, VA 22201

Fax: 703.907.7583

---

1. I recommend changes to the following:

☐ Requirement, clause number \_\_\_\_\_

☐ Test method number \_\_\_\_\_ Clause number \_\_\_\_\_

The referenced clause number has proven to be:

☐ Unclear ☐ Too Rigid ☐ In Error

☐ Other \_\_\_\_\_

---

2. Recommendations for correction:

---

---

---

---

---

3. Other suggestions for document improvement:

---

---

---

---

---

Submitted by

Name: \_\_\_\_\_

Phone: \_\_\_\_\_

Company: \_\_\_\_\_

E-mail: \_\_\_\_\_

Address: \_\_\_\_\_

City/State/Zip: \_\_\_\_\_

Date: \_\_\_\_\_

---

