SLOVENSKI STANDARD
SIST-TS ES 59008-4-1:2007
01-januar-2007

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Data requirements for semiconductor die -- Part 4-1: Specific requirements and recommendations - Test and quality

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Ta slovenski standard je istoveten z: ES 59008-4-1:2000

ICS:

31.080.01	Polprevodniški elementi (naprave) na splošno	Semiconductor devices in general

SIST-TS ES 59008-4-1:2007 **en**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN SPECIFICATION

SPÉCIFICATION EUROPÉENNE

EUROPÄISCHE SPEZIFIKATION

ES 59008-4-1

September 2000

English version

Data requirements for semiconductor die
Part 4-1: Specific requirements and recommendations
Test and quality

This European Specification was approved by CENELEC on 2000-05-25.

CENELEC members are required to announce the existence of this ES in the same way as for an EN and to make the ES available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Ref. No. ES 59008-4-1:2000 E

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Foreword

This European Specification has been prepared by the CENELEC BTTF 97-1, Known good die.

It was submitted to the vote during the meeting of BTTF 97-1 and approved by CENELEC as ES 59008-4-1 on 2000-05-25.

The following date was fixed:

- latest date by which the existence of the ES has to be announced at national level (doa) 2000-10-01

The structure of this European Specification is as follows.

ES 59008 Data requirements for semiconductor die
- Part 1 General requirements
- Part 2 Vocabulary
- Part 3 Mechanical, material and connectivity requirements
- Part 4 Specific requirements and recommendations
  - Part 4-1: Test and quality
  - Part 4-2: Handling and storage
  - Part 4-3: Thermal
  - Part 4-4: Electrical simulation
- Part 5 Particular requirements and recommendations for die types
  - Part 5-1: Bare die
  - Part 5-2: Bare die with added connection structures
  - Part 5-3: Minimally-packaged die
- Part 6 Exchange data formats and data dictionary
  - Part 6-1: Data exchange - DDX file format
  - Part 6-2: Data dictionary

Introduction

This European Specification has been developed to facilitate the selection of unpackaged and minimally-packaged semiconductor die, with or without connection structures in order to save both design and procurement time.

It is a data specification which defines the requirements for :
- product identity
- product data
- die mechanical information
- test, quality and reliability information
- handling, storage and mounting information
- thermal data and electrical simulation data.

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This document was prepared by CENELEC Task Force CLC/BTTF 97-1 Known Good Die. Other organisations that helped prepare it were : the ESPRIT GOOD-DIE projects, EECA, Sematech, DPC and EIAJ.

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The specification was derived from the work carried out in the ESPRIT 4th Framework project GOOD-DIE. This project was set up to develop a database for the selection of unpackaged and minimally-packaged semiconductor die, with or without connection structures, and for the downloading of information to CAD design stations to facilitate the layout and simulation of MCMs and hybrid circuits. During the early part of the GOOD-DIE project the need was identified for a standard way of presenting information for the selection and procurement of these components.

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1 Scope

This series of European Specifications specifies requirements for the exchange of data pertaining to bare semiconductor die, with or without connection structures, and minimally packaged semiconductor die.

This Specification also gives recommendations for general industry good practice in the use of bare die, with or without connection structures, and minimally packaged die.

ES 59008-4-1 specifies the requirements for the data needed to describe the test and quality parameters of the die.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this European Specification. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this European Specification are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below.

ES 59008-1:1999, *Data requirements for semiconductor die -- Part 1: General requirements*

ES 59008-2:1999, *Data requirements for semiconductor die -- Part 2: Vocabulary*

ES 59008-3:1999, *Data requirements for semiconductor die -- Part 3: Mechanical, material and connectivity requirements*

ES 59008-6-1:1999, *Data requirements for semiconductor die -- Part 6-1: Data exchange - DDX file format*

ES 59008-6-2:200X, *Data requirements for semiconductor die --Part 6-2: Data* dictionary

IEC 61360:1995 (series), *Standard data element types with associated classification scheme for electric components*

3 Definitions

For the purpose of this European Specification, the definitions as given in ES 59008-2 apply.

4 Requirements

This Part 4-1 of ES 59008 shall be read in conjunction with ES 59008-1 and ES 59008-3. Particular attention shall be given to the data requirements for conformity levels, as defined in ES 59008-1 and ES 59008-3.

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5 Availability of information and conformity

5.1 Publication of data

Whilst it is expected that much of the information supplied in conformance with this European Specification will be in the public domain and available from such sources as manufacturers' data sheets, this specification does not place an obligation on a supplier to make information public. Any information that a supplier considers to be proprietary or commercially sensitive may be supplied under the terms of a Non-Disclosure Agreement.

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5.2 Data tabulation and exchange

For ease of convenience and uniformity, annex A to E provides the preferred coding system for use within the DDX format, whereby the data may be simply and easily assigned in accordance with the parameters defined in ES 59008-6-1, ES 59008-6-2 and of IEC 61360. The use of this coding system is strongly encouraged, to permit simple database comparisons primarily for procurement purposes. Informative annex F provides an explained example of the codes.

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5.3 Conformity level

When any data are supplied which claim conformity to this part of the specification, the level of conformity shall be stated as follows:

- **Level 1**: The supplier of the die device shall provide either :
  - a) a figure for minimum yield or maximum DPM, under specified test conditions, as covered in **clause 6**, or
  - b) sufficient information on test conditions and procedures, as covered in **6.3 and clause 7**, to allow the user to assess the suitability of the die device for use within the user's application and end product.

- **Level 2**: The supplier of the die device shall provide, in addition to the requirements of level 1 conformity, either :
  - a) all data covered in **clauses 6 and 7**, or
  - b) equivalent statements that adequately cover the requirements of **clauses 6 and 7**.

- **Level 3**: The supplier of the die device shall provide in addition to the requirements of level 1 and level 2 conformity either :
  - a) all data covered in **clauses 6, 7 and 8**, or
  - b) equivalent statements that adequately cover the requirements of **clauses 6, 7 and 8**.

Table 1 shows the data to be considered when determining the appropriate product definition. The combination of these data will define the overall quality, reliability and suitability for purpose of the die device.

Table 1— Product definition data

Subclause	Data
6.1	Yield
6.2	Operating Temperature Range
6.3	Electrical Test
7.1	Test Temperature Range
7.2	Compliance to Standards
8.1	Screening
8.2	Reliability
8.3	Product maturity

6 Essential information

6.1 Yield

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Final module yield is dependant upon a combination of factors, including but not limited to, the individual die device DPMs, quantity of die in the module, substrate design, handling and storage, wire bond and die attach. This clause addresses only an individual die device. With that in mind yield is defined as being "*as received*", and not as being "*as assembled*". Device DPMs are quoted against specific test conditions and not necessarily against the user's application.

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Yield considerations are a major factor in the selection of semiconductor die devices. Semiconductor die devices are intended to be considered as replacement for equivalent packaged product. However, die devices do not necessarily carry the same yield expectations as their packaged product counterparts. This is due to many reasons, of which two key elements are as follows:

- Electrical performance specifications and/or datasheets provided by the die manufacturer or supplier are typically based on specific condition of product (product test conditions identified in a particular package or in die form). Actual die device performance will be dependant on the user's choice of assembly process, materials and circuit design / layout / interconnect.

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- Final yield of the die device will be dependant on the assembly process, handling and material choices made by the user. As such, yield information provided by the supplier is based upon "*as shipped*" product condition.

This information has to be clearly understood by both the purchaser and designer of systems using unpackaged die or die devices. It is recommended, therefore, that prior to extensive use of this yield information, the user consults with the die manufacturer or supplier, and allows for exposure of his design and other processes involved. It is also stressed that any supplied yield data, if deemed sensitive, can be subject to a Non-Disclosure Agreement between supplier and vendor (refer to 5.1).

For information pertaining to the calculation of module yields with only the quantity of semiconductor die considered consult annex A. The actual yield model employed by the user of die shall include reliability modelling of all components and processes to properly determine final product yield.

For convenience and use with ES 59008-6-1, the outgoing quality of the semiconductor die may be indicated using a ***yield code*** as given in annex A.

6.2 Operating temperature range

The manufacturer or supplier shall specify the operating temperature range for the die device.

6.3 Electrical test

Suppliers of die devices employ a variety of test procedures and techniques to test, guarantee and/or characterize electrical performance of die device. These techniques or procedures are, in most cases, similar to the testing performed on their packaged product counterparts. As with packaged product, the important information is not contained in the actual test methods employed by the supplier, but rather in the resulting electrical test specification / datasheet identified by the die device supplier. The applicable information will include the operating range for the die device.

As defined in the yield consideration (refer to 6.1), the user of the die device has the responsibility to understand and/or model the die device's electrical performance in the intended application. This ultimately will determine the acceptability of the standard electrical performance specification in the intended application with considerations for use environment, system life requirements, ease or difficulty of rework or replacement, etc.

The manufacturer or supplier shall specify what parameters are guaranteed, but it is the customer's responsibility to review all data supplied for suitability within his module design requirements and end application.

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For convenience and use with ES 59008-6-1, the test flow to which the die device was subjected during manufacture may be indicated using the ***test flow code*** as given in annex B.

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7 Desirable information

7.1 Test temperature range

The manufacturer or supplier shall specify the test temperature range to which the die device was subjected during the course of testing and/or screening. It is stressed that this information, if deemed sensitive, can be subject to a Non-Disclosure Agreement between supplier and vendor (Refer to 5.1).

For convenience and for use with ES 59008-6-1, the temperatures to which the die device was subjected during electrical test may be indicated using the ***temperature code*** as given in annex C.

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7.2 Compliance to standards

The compliance of the die device to general or specific standards, where applicable, shall be stated.

8 Optional information

8.1 Device screening

Additional screening, other than those already mentioned in 6.3 and 7.1, may be employed by the manufacturer or supplier, for the purposes of standards compliance, or for enhancing outgoing reliability.

For convenience and use with ES 59008-6-1, the environmental screening to which the die device was subjected may be indicated using the ***screening code*** as given in annex D.

8.2 Reliability

This clause only covers the **availability** of reliability data, not the provision of the reliability data itself. Final module reliability is a combination of the individual die 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, and only as "*as received*", not "*as assembled*". This reliability information, if deemed sensitive, can be subject to a Non-Disclosure Agreement between supplier and vendor (Refer to 5.1).

For convenience and use with ES 59008-6-1, the availability of reliability data for the die device may be indicated using the ***reliability code*** as given in annex E.

8.3 Product maturity

For any medium to long-term manufacture of a product, the current and future availability of the component parts becomes part of the design and development process. Furthermore, the stability of batch-to-batch variations becomes relevant when procuring either untested or partially tested die devices, typically in wafer form, so it becomes important for the die device user to understand the product maturity, and the manufacturing process status of the die device before committing to design or production. However, this product / process maturity information is **highly time dependant**, and ideally ought to be sought by the user, from either the manufacturer or supplier, both at product quotation **and** at product order acknowledgement.

The manufacturer shall make available, upon request, information as to the availability and status of the product. The manufacturer or supplier shall also inform existing customers when the availability or supply status is deteriorating, or when there is an impending electrical/mechanical change to the die device, such as a die shrink.

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Annexe A (normative)

Yield code and yield calculations

A.1 Yield code

The ***yield code*** is intended for comparative measurements between the same functional die between different suppliers, or between differing screening routines. It may be included as a parameter with the DDX file format, refer to annex F and ES 59008-6-1 for further information.

The ***yield code*** has a value dependent on the quality of the semiconductor die as tabulated below. This yield code also implicitly indicates the number of defects per million parts (DPM), which is the outgoing quality of the semiconductor die and is simply the difference, in DPM, between the achieved semiconductor die yield and 100 % (e.g. a die yield of 98 % indicates 20 000 DPM). Additionally, this code gives an indication of the number of such dies that can be assembled in a single module or package which would still result in an overall final yield of 96 % or better.

If the ***yield code*** is given as “X”, (yield unknown), then the desirable information, as required in clause 7, becomes all the more important and relevant, and so should be supplied as alternative information. Where possible, information suppliers should be wary of using the “X” code, (yield unknown), as a ***yield code*** unless the yield is really unknown; it is preferable to give a conservative estimate than none at all. It is also stressed that this data, if deemed sensitive, can be subject to a binding Non-Disclosure Agreement between supplier and vendor (Refer to 5.1).

The ***yield code*** shall take one of the following values:

Table A.1 — Yield code

Yield code	N	Yield of die	DMP-level
X	n/a	N/a	n/a
Y	n/a	> 80%	< 200 000
Z	n/a	> 90%	< 100 000
0	1	> 96%	< 40 000
1	2	> 97,98%	< 20 204
2	4	> 98,99%	< 10 154
3	8	> 99,49%	< 5 090
4	16	> 99,75%	< 2 548
5	32	> 99,87%	< 1 275
6	64	> 99,94%	< 638
7	> 100	> 99,97%	< 319
8	> 200	> 99,98%	< 159
9	> 500	> 99,99%	< 80
A	> 1 000	> 99,996%	< 40
B	> 1 000	> 99,998%	< 20
C	> 1 000	> 99,999%	< 10
D	> 1 000	> 99,999 5%	< 5
E	> 1 000	> 99,999 8%	< 2
F	> 1 000	> 99,999 9%	< 1

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where:

N is the number of semiconductor die planned in the final module.

DPM level is the DPM-level indicating the out-going quality of the semiconductor die.